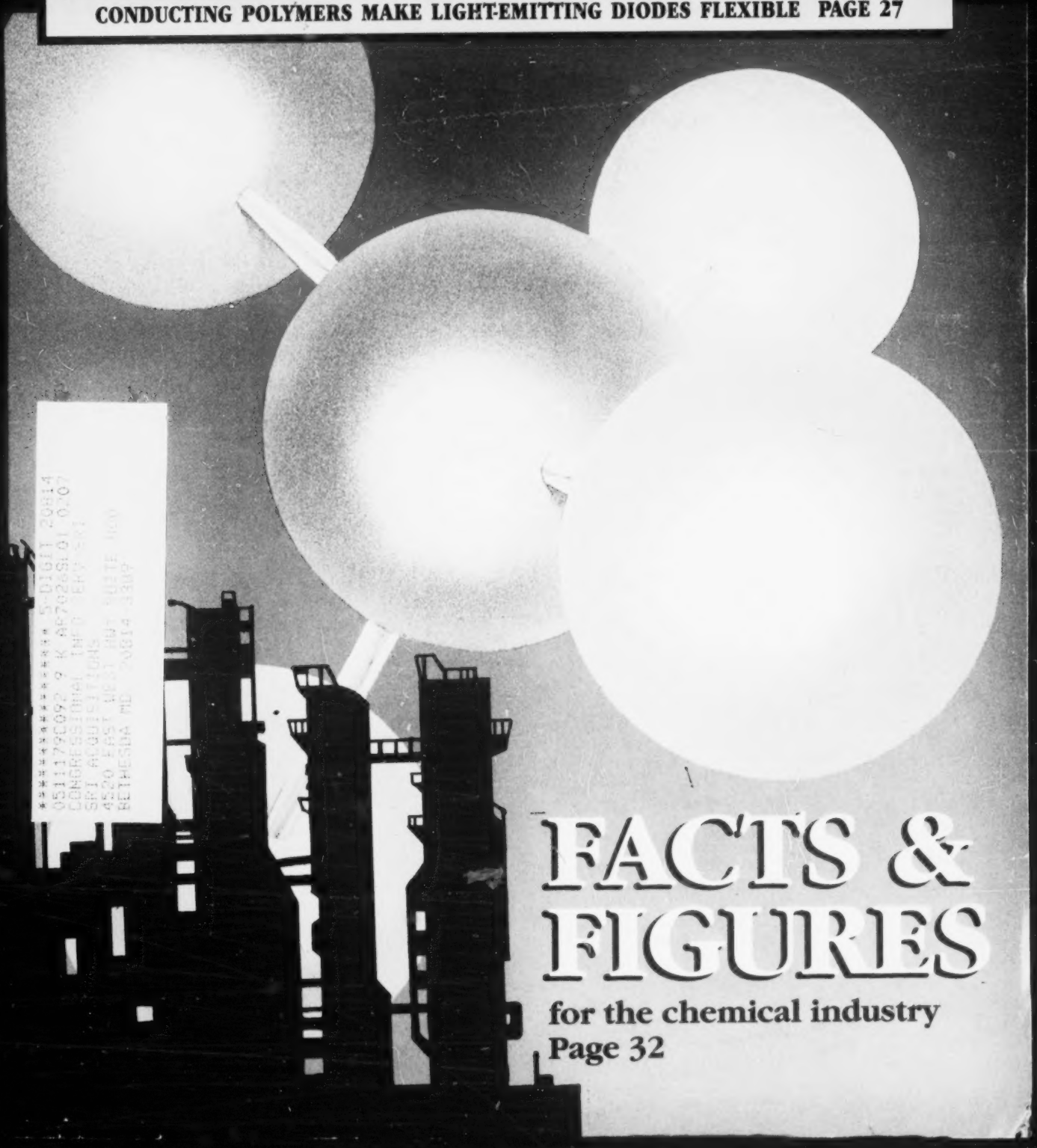
CHEMICAL & ENGINEERING NEWS

C&EN

JUNE 29, 1992

CONDUCTING POLYMERS MAKE LIGHT-EMITTING DIODES FLEXIBLE PAGE 27



FACTS & FIGURES

for the chemical industry
Page 32

CHEMICAL & ENGINEERING NEWS

C&EN

JUNE 29, 1992

NEWS OF THE WEEK

- Several chemists and Merck & Co. are among the recipients of 1992 National Medals of Science and National Medals of Technology. Page 6
- Hercules and Fluor Daniel sign agreement to jointly offer disposal services for explosives, propellants, munitions, and rocket motors, joining several other firms pursuing weapons destruction business. Page 7
- New drug, Proscar, developed by Merck for treating enlarged prostate glands in place of surgery, has been approved by FDA for marketing. Page 7
- Team of four U.S. students has been chosen to compete in chemistry olympiad in Pittsburgh in July, following recent training camp. Page 8
- Fatal lab explosion last winter during cold fusion experiment at SRI International was caused by unexpected buildup of deuterium and oxygen gases in an electrolytic cell. Page 8

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BUSINESS

Canadian chemical industry is still trying to recover from recession, despite signs the country's domestic economy is beginning to improve. Page 11

GOVERNMENT

Plans to build incinerators for chemical arms destruction may be thwarted because of Army's failure to consider political, social, and regulatory obstacles to such facilities. Page 19

U.S. companies must learn to use capital better to improve their competitive position in the global marketplace, according to a study from the Council on Competitiveness. Page 21

SCIENCE/TECHNOLOGY

Flexible, light-emitting diode made from conducting polymers is significant development in semiconductor technology. Page 27

Studies of catalysis are the focus of R&D efforts in China, especially those related to the processing of heavy crude oils peculiar to that country. Page 28

EDUCATION

Hong Kong University of Science & Technology completes its first year, despite controversies about its operating costs and methods of teaching. Page 31

BOOKS

"Scientific Knowledge in Controversy: The Social Dynamics of the Fluoridation Debate" examines the sociological impact of science in the political fights over fluoridation of water. Page 76

ACS NEWS

Dale Baker, former director of CAS, has been selected to receive the ACS Board of Directors Distinguished Service Award for Senior ACS Administrators. Page 79

ACS membership dues, slated to rise to $93 in 1993, will mean an increase in the allocation from members' dues to C&EN, local sections, and divisions. Page 80

FACTS & FIGURES

The recession took its toll on the chemical industry in 1991, but there were some signs by year's end that things may be getting better. C&EN's annual statistical compilation wraps up recent results in the U.S. and abroad. Page 32

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LETTERS

German scientists

In his letter (C&EN, June 8, page 3), Walter Moore is quite correct in stating that very few of the German scientists who did not have Jewish connections resigned and emigrated from Germany during the Nazi period. Among other things, money and positions abroad were limited and quite properly went to those in distress. I believe, however, that he greatly exaggerates the admiration of the senior scientists for Hitler. Max Planck, for one, despised and feared Hitler. Soon after Hitler took office, Planck attempted to convince him he was on the wrong course, but he was viciously rebuffed. The quotation given involving him is out of context.

Samuel Goudsmit, the senior scientist of the ALSOS mission, rescued Planck from desperate circumstances in 1945. Since Goudsmit had lost his parents in one of the extermination camps, he would not have provided such help if he had doubts about Planck's position.

I served in General Eisenhower's headquarters in Frankfurt in 1945 as part of his intelligence office and visited many university administrative offices to look over the official records of the staff. Almost none of those who had been tenured in 1933 were or became party members. After that, it was essentially impossible to receive a faculty appointment unless you were a member, but that is a different matter.

Frederick Seitz
President Emeritus
Rockefeller University
New York City

Drug design

Although Benjamin J. Luberoff certainly makes a number of valid points (C&EN, June 15, page 2) about the ability of a computer to design a drug molecule, his ignoring some of the positive aspects of molecular modeling does a serious disservice to this rapidly growing activity. Most researchers who have done computer-assisted drug design calculations are certainly well aware of the apparent oversimplifications inherent in their modeling, but at the same time they realize that this in itself can yield valuable insights.

A relatively old, but still very significant, example of this can be found in the work by Sid Topiol and colleagues [*J. Chem. Phys.* **68**, 2364 (1978); **70**, 3008 (1979); and later papers] on the binding of various molecular species such as LSD (and other agonists) to 5-HT (serotonin). Despite the fact that the biological reactions being studied occur in complex aqueous in-vivo systems, the electron-density maps constructed on the basis of gas-phase structures correlate surprisingly well with a number of known physiological facts.

This suggests that either the details of complexation with water are relatively unimportant or are somehow incorporated in some of the approximations used. In any event, the results of the calculations are strongly suggestive and certainly promise to further our understanding of some very complex biochemical processes, many of which will probably always remain elusive to the experimentalist.

Of course, Luberoff is entirely correct about finding no mention of any actual contribution to the solution of a commercially significant problem in the article on computer-aided chemistry (C&EN, May 11, page 40). However, many chemists—this writer included—did not enter the field of chemistry to get rich.

Frank L. Pilar
Professor of Chemistry
University of New Hampshire
Durham, N.H.

Cold fusion

In his recent review of "Cold Fusion: The Scientific Fiasco of the Century" by J. F. Huizenga (C&EN, May 25, page 23), Ron Dagani gives considerable space to Huizenga's discussion of a paper by Jack Simons and me, "Two Innocent Chemists Look at Cold Fusion" [*J. Phys. Chem.* **93**, 4693 (1989)]. I've examined the book with some care, and the review properly depicts Huizenga's statements. However, I think these grossly misrepresent both the chronology surrounding the paper and its tenor and purpose and make us look more naive and gullible than we actually were. Since I suspect that the review will

Correction

- June 15, page 1: The cover photo illustrating food additives was courtesy of National Starch & Chemical, not FMC.

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Canada's Chemical Industry Struggles To Recover from Recession

■ ***Although domestic economy seems to be mending, chemical export and production figures are mixed at best***

Like many of its counterparts throughout the world, the Canadian chemical industry is struggling to recover from a recession that has caused sales to fall and profits to plummet. And, like so many of its counterparts, the industry is finding recovery to be a painfully slow process. Witness the following comments from industry leaders.

Alban W. Schuele, president of Celanese Canada, says the short-term outlook does not appear very promising. And, he adds, "there does not seem to be any opportunity at this time for improved earnings."

Speaking of his company's chemicals operations, J. E. (Ted) Newall, president and chief executive officer of Nova Corp. of Alberta, says he expects "much lower losses" in 1992. Still, that spells losses.

Arthur R. Sawchuk, Newall's counterpart at Du Pont Canada, is a bit more optimistic. He believes the fundamentals for an economic recovery in Canada are in place. As a result, he says volumes and prices of chemicals "will slowly strengthen as the year progresses." But even in these remarks, the key word is "slowly."

In Canada, there are, indeed, signs that the domestic economy is inching toward recovery. Employment is up in the manufacturing sector. Productivity is improving. Gross domestic product is gaining. And interest rates have moved noticeably lower.

But the domestic market in Canada is small. For most Canadian chemical companies, exports are critical. This is particularly true of companies that produce large-volume, commodity petrochemicals in world-scale plants.

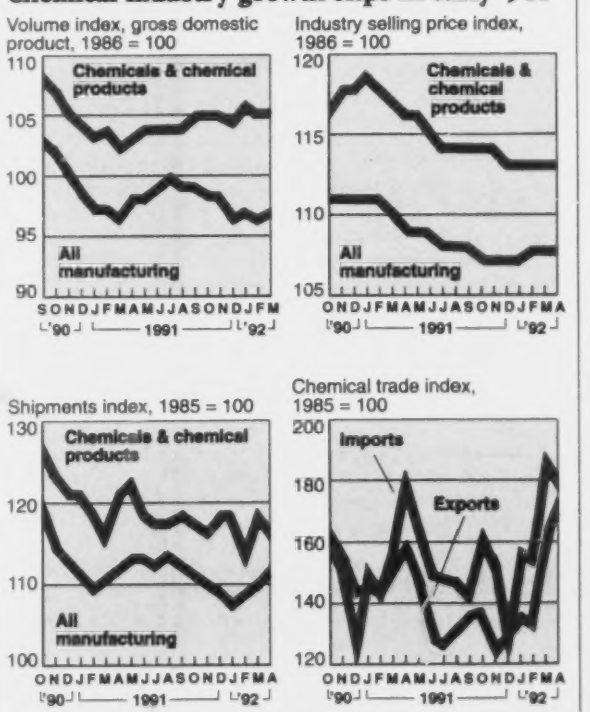
So far this year, exports are flashing mixed signals. Through the first four months, Canadian chemical exports were $2.3 billion at current exchange

Plastics register big gains in output

Production, thousands of metric tons	1991	First four months 1992	First four months 1991	% change 1991–92
INORGANICS				
Ammonia	3669	1255	1208	3.9%
Ammonium nitrate	963	365	340	7.4
Chlorine	1402	481	485	–0.8
Hydrochloric acid	193	62	67	–7.5
Nitric acid	912	320	315	1.6
Sodium chlorate	695	245	240	2.1
Sodium hydroxide	1498	508	526	–3.4
Sulfuric acid	2953	1136	1029	10.4
ORGANICS				
Benzene	712	246	266	–7.5
Ethylene	2425	837	850	–1.5
Formaldehyde	114	42	37	13.5
Methanol	2223	740	772	–4.1
Propylene	717	246	259	–5.0
Toluene	364	134	130	3.1
Urea	2397	896	785	14.1
Xylenes	391	131	164	–20.1
PLASTICS				
Polyesters, unsaturated	33	12	9	33.3
Polyethylene, high density	458	215	127	69.3
Polyethylene, low density	1111	353	399	–11.5
Polystyrene*	167	60	59	1.7

*Includes ABS (acrylonitrile-butadiene-styrene resins) **Source:** Statistics Canada

Chemical industry growth slips in early '90s



Source: Statistics Canada

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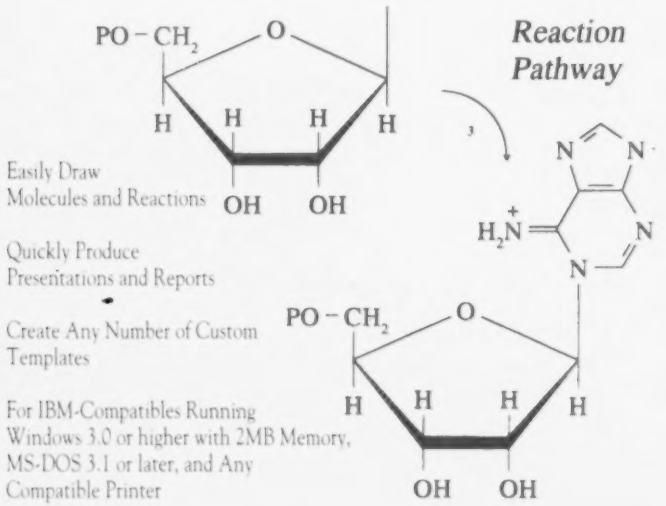

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rates. That's a paltry 0.4% better than they were during the same period last year and not enough to push production levels upward for most chemical products.

However, chemical exports in March and April, the latest months for which data are available, were strong. In fact, those two figures were higher than they have been for the past two years.

Certainly, exports have given a boost to polyvinyl chloride. Output through the first four months of the year was up a hefty 58%. The domestic market for fabricated PVC products is not that strong. But the export market, primarily to the U.S., has improved dramatically.

Still, overall chemical shipments were essentially flat through April, and the price index has remained stuck in neutral. However, the production index is starting to recover from the lows it reached in March last year.

Chemical production figures present a mixed bag. Polyethylene illustrates this better than anything else. Through the first four months of 1992, output of low-density polyethylene slumped 11.5% from year-earlier levels. Yet, high-density polyethylene production soared 69%. Part of the reason for the discrepancy: Dow Chemical Canada's low-density polyethylene plant in Sarnia, Ontario, was damaged by a fire and was only put back on stream in late April.

The picture is the same throughout the entire spectrum of organic and inorganic chemicals: urea output up 14%, xylenes down 20%; toluene slightly higher, ethylene slightly lower. Among inorganics, sulfuric acid producers have boosted production 10% and ammonia output is almost 4% higher. But chlorine and hydrochloric acid output still are below last year's levels.

If Canada can resolve its constitutional problems and, at the same time, keep its economic recovery on track, its chemical industry likely will mount a sustained recovery drive of its own. But it still is too early for sighs of relief.

Canada's pulp and paper industry, a major outlet for Canadian chemicals, remains in the doldrums. On the other hand, economists expect a slight recovery in construction activity, which bodes well for some chemicals. Faced with this dichotomy of indicators, chemical industry executives are crossing their fingers and hoping for the best.

Earl Anderson

Army's Plans for Destroying Chemical Weapons Likely To Be Waylaid

■ ***Failure to consider political, social, regulatory obstacles to proposed incinerators may block their construction***

Lois R. Ember, C&EN Washington

Just issued reports and Congressional hearings and bills are conspiring to focus a bright spotlight on the chemical weapons destruction issue. And all this activity is likely to make it more difficult for the Army to carry out its plans to build destruction facilities at eight sites across the U.S.

That plan began to gel in 1984 when, with the endorsement of the National Academy of Sciences, the Army decided that the best way to destroy the U.S. chemical stockpile was to dismantle the munitions and then incinerate the separate parts: chemical agent—nerve or mustard gas—explosives, metal parts, and dunnage (contaminated waste). About four years later, the Army further decided that on-site disposal of chemical weapons at the eight U.S. storage sites would be the safest way to eliminate them. The alternative would have been to transport the weapons to Johnston Atoll in the Pacific Ocean and/or to regional U.S. sites for disposal.

According to Walter L. Busbee, who directs the destruction program, the total stockpile of about 25,000 tons of chemical agents can be destroyed by December 2000 at a cost of nearly $8 billion. What he doesn't say publicly is that mechanical difficulties as well as political, environmental, and legal hurdles are very likely to stretch out the deadline and increase the cost.

Over the years, the Army has focused on incineration, particularly on its technical and economic aspects, and has failed to consider political, social, and regulatory obstacles. Overlooking these barriers and failing to have a backup plan may be the Army's undoing, concludes a just released study by Congress' Office of Technology Assessment.

OTA analyst Mark A. Brown, an author of "Disposal of Chemical Weapons: Alternative Technologies," explains: "The basic issue is one of lack of trust. People just don't trust the Army to have the citizens' best interest at heart and to do a good job to make sure their health and environment are protected."

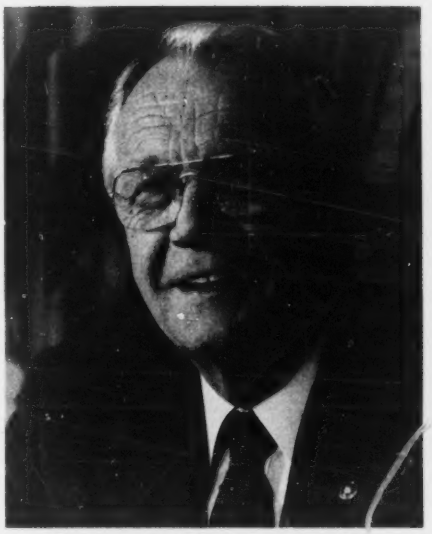
The Army is now testing full-scale operation of its incineration program on Johnston Atoll. It then wants to export the technology to eight continental U.S. sites.

Brown says the Army has yet to realize that "it doesn't really matter whether [the technology] works or not." For some communities and states that have chemical stockpiles, and for several national and international environmental groups, what matters is "trust and credibility," Brown insists. Both the Army and its chosen technology, incineration, lack these attributes.

The focused, well-organized opposition from citizens, states, and environmental groups could seriously delay, if not prevent, the construction of eight U.S. disposal facilities. So OTA recommends the Army begin now to look at other destruction technologies, and to include early and continuous public participation in decision-making.

Although Congressional mandates and unratified treaty obligations fix destruction deadlines around the turn of the century, these appear to be flexible constraints. Barring a rapid deterioration of the chemical stockpile, which current data indicate is unlikely, the Army has the time to research, test, and implement an alternative destruction technology.

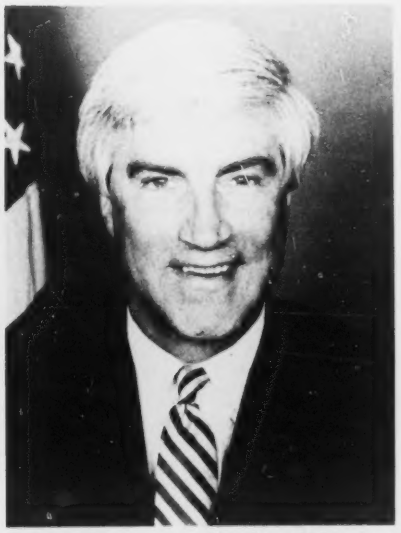
At the request of Sen. Wendell H. Ford (D.-Ky.), whose state would house one of the disposal facilities, OTA looked at four alternative methods out of a number that have been suggested as possibilities by the environmental group Greenpeace and defense contractors. None of the four—chemical neutralization, supercritical water oxidation, steam gasification, and plasma arc pyrolysis—has been used to destroy chemical weapons. Each is claimed to offer advantages over incineration because each would minimize air emissions and would possibly improve safety during on-site handling and transportation exercises.



Ford: requested look at alternatives

In addition, some groups opposing incineration would also like a technology specific to the destruction of chemical weapons so that it could not be used later to destroy other communities' hazardous waste. And these groups would also like to see the development of an effective community emergency response program.

Unfortunately, there is not enough information for OTA to be able to recommend which of these four alternative methods the Army could adopt for development. Furthermore, the OTA study states, "It is quite possible that if a successful alternative technology is



McMillen: opposes Aberdeen, Md., site

developed for [chemical weapons] destruction, it will be none of these."

Instead, it may be one chosen from a number of alternative disposal methods now being examined by a National Research Council committee. Brown cautions, however, that if the NRC committee considers only technical issues and fails to look at sociopolitical criteria, "then the new technology selected may not offer any advantages over the current technology."

According to NRC staff officer Donald L. Siebenaler, the committee is charged only with looking at "the scientific and technical aspects of the alternatives, not with assessing the political or environmental ramifications of these technologies." Also, he explains, the panel will not select a single alternative technology to incineration, nor will it rank the options.

Still another NRC committee, one which earlier certified the Army's chosen disposal method, has again, in a just released report, concluded that "incineration followed by appropriate gas cleanup is a safe and effective technology for the destruction of chemical agents and munitions." The panel bases its conclusion in part on data collected at the Johnston Atoll facility.

In this latest report, the NRC panel recommends steps that merely fine-tune the incineration system. The panel never considers the possibility that public outcry could prevent the eight other incinerators from being built.

Nor does the Army in its public statements. At a recent hearing by the House Subcommittee on Energy, Environment & Natural Resources, Busbee mentioned that before the Army could build disposal facilities, it had to obtain operating permits under the Resource Conservation & Recovery Act. But he failed to name several other regulatory hurdles.

Busbee did say that "no current or proposed state laws ... prohibit the construction and operation of a chemical weapons destruction plant." But he failed to indicate publicly how restrictive recently passed Kentucky and Indiana laws are that govern such facilities. These laws may make it nearly impossible fo the Army to obtain state permits for operating incinerators.

Rep. C. Thomas McMillen (D.-Md.), testifying at the same hearing, said that "Maryland is contemplating enacting similar legislation." McMillen opposes incineration at Aberdeen Proving Grounds in Maryland, because this chemical weapons storage site is in a populated area, and air emissions from the incinerators could adversely affect the nearby Chesapeake Bay.

So opposed is McMillen to the Army's plans that he, along with Rep. Larry J. Hopkins (D.-Ky.), whose district includes the Lexington-Blue Grass storage site, offered an amendment to the 1993 Defense Authorization Bill that would make it nearly impossible for the Army to build incinerators in Maryland, Kentucky, or Indiana. These three states possess the smallest stockpiles, yet have marshalled the most intense state and citizen opposition.

That amendment, approved by the House, changes the current deadline for disposing of the stockpile from 2000 to a date reflecting deadlines in a future treaty banning global chemical weapons. It also creates an independent commission composed of members of the general public as well as technical people to report on alternative disposal options. And it increases the role of public health and safety in the Army's decision-making process.

A similar bill has recently been offered in the Senate by Sen. Ford and Sen. Barbara Mikulski (D.-Md). The Ford-Mikulski bill would also set up an independent advisory commission that would report back to Congress in 1994.

Echoing a key finding of the OTA report, which he commissioned, Ford says, "A disturbing aspect of the current situation regarding the stockpiles is that the Army has no contingency plan in the event Kentucky or another state denies an environmental permit to build an incinerator."

According to Richard A. Davis, General Accounting Office director for Army issues, who also testified before the House hearing, the Army is likely to encounter delays in obtaining environmental permits needed to begin construction of incinerators at Anniston Depot, Ala., and Lexington-Blue Grass, Ky. Because of these delays, GAO recommends deferral of the Army's 1993 funding request totaling $163 million for construction and incineration equipment at these sites.

The Senate is expected to mark up the Defense Authorization Bill early next month. The House has passed its version already. □

Army plans to destroy chemical stockpile by 2000

Location	% of total U.S. stockpile	Start facility construction	Start testing system	Start operations	End operations
Johnston Atoll (Pacific Ocean)	6.6%	Nov. 1985	Aug. 1988	July 1990	Oct. 1995
Tooele Army Depot (Utah)	42.3	Sept. 1989	Aug. 1993	Feb. 1995	April 2000
Anniston Depot (Ala.)	7.1	June 1993	April 1996	Oct. 1997	Nov. 2000
Umatilla Depot (Ore.)	11.6	Jan. 1994	Nov. 1996	May 1998	Dec. 2000
Pine Bluff Arsenal (Ark.)	12.0	Jan. 1994	Sept. 1996	March 1998	Nov. 2000
Lexington-Blue Grass (Ky.)	1.6	May 1994	March 1997	Sept. 1998	Feb. 2000
Pueblo Depot (Colo.)	9.9	May 1994	March 1997	Sept. 1998	May 2000
Newport Ammo Plant (Ind.)	3.9	Jan. 1995	June 1997	June 1998	April 1999
Aberdeen Proving Ground (Md.)	5.0	Jan. 1995	June 1997	June 1998	June 1999

Note: This schedule does not take into account delays from major system failures or litigation and is dependent on funding support. **Source:** Army

FACTS

Recession hit the chemical industry in 1991 as it did the rest of the economy; but for chemicals, at least, it seemed more like a lingering head cold than a full-fledged bout of the flu. Though there's no doubt that last year was the second in a row of poor performance for U.S. chemical makers, there were signs by year's end that the worst might be over. If so, then the industry's most recent recession, though dragging on, may turn out to have been a relatively mild one.

Earnings fell 16% in 1991 for the group of key chemical companies that C&EN tracks, following a 22% drop the previous year. This loss of revenue began to take its toll in the industry's ability to invest in its future, as capital spending declined and even R&D funding failed to keep pace with inflation. Production leveled off last year, ending a decade of steady gains, as some of the biggest markets for chemical output posted their third or fourth year of poor performance.

But things may be better in 1992. Though sales and earnings were down for the first quarter for chemical makers as a group, big losses at one company probably distort this picture. Most major chemical companies saw increases in sales, earnings, production, and profitability for the quarter. And some important chemical markets, notably new housing starts, had also turned around in the early months of 1992.

A more detailed look at the health of the chemical industry in the U.S. and, to a lesser extent, in the rest of the chemical-producing world is presented on the following pages in C&EN's annual statistical compilation of the relevant facts and figures. These data come from a variety of sources, including government agencies, international organizations, trade associations, and chemical companies themselves. In some cases, C&EN has pulled together raw data from several sources to develop analytical measures that bring the industry's performance into sharper focus.

At a glance

1 PRODUCTION

Production by the U.S. chemical industry in 1991 stayed at its 1990 level, posting no change at all when measured by broad, industry-wide performance or that of the 50 largest volume commodity chemicals. Most of the major sectors of the industry stayed close to 1990 production, too, with very modest gains in the organics, plastics, and synthetic fibers sectors offset by losses in synthetic rubber and fertilizers. The picture was mixed for industrial inorganic chemicals. Page 34

2 FINANCES

Sales, earnings, and profitability all declined in 1991. Falling prices led to a 1% drop in sales for the 30 chemical companies C&EN surveys

& FIGURES

for the chemical industry

regularly, and whose output leans **heavily toward indu**strial chemicals. **As a group, their** profits fell 16% to a **four-year** low of $4.47 billion. Specialty chemical makers and drug companies did somewhat better. Capital spending at chemical firms also fell 16% last year, and these firms' modest increases in R&D spending failed to keep pace with inflation. **Page 41**

3 EMPLOYMENT

Chemical industry employment reached a peak of 1.09 million people early in 1990 and eased downward for the remainder of that year. It's been holding steady at about 1.07 million since March 1991. Among the larger chemical companies, employment fell 3% in 1991, following a 2% decline in 1990. At the same time, hourly production wages rose, so that productivity gains brought about by a smaller work force were largely offset by higher labor costs. **Page 55**

4 MARKETS

Major markets for chemicals generally did poorly in 1991, reflecting the broader trends of the U.S. economy. Some of the most important markets, including new housing and automobiles, fared worse than consumer spending generally in what was only the most recent in a string of poor years. **Page 60**

5 FOREIGN TRADE

The U.S. chemical trade surplus reached an all-time high of $18.8 billion in 1991, making that the sixth year in a row of record-setting trade surpluses. Trade was strong to all parts of the world except the formerly communist countries of Eastern Europe, as U.S. chemical exports jumped 10%. Imports were up 8%. **Page 62**

6 FOREIGN CHEMICAL INDUSTRIES

Downturn characterized the chemical industries throughout the industrialized world in 1991. Although chemical makers in Germany, France, and the U.K. increased sales by 3% last year, most had declines in earnings; and chemical companies in the rest of Western Europe, in Japan, and in Canada generally saw sales and earnings fall. In Eastern Europe, chemical production, like industrial production generally, fell sharply last year for the second year in a row. **Page 64**

Chemical production held steady in 1991

At first glance, production by the U.S. chemical industry in 1991 continued at the same steady levels of 1990. According to data for the year as a whole from the Federal Reserve Board, production of chemicals and allied products didn't change at all in 1991. Production of the largest volume chemicals, C&EN's Top 50, was similarly stagnant for the year.

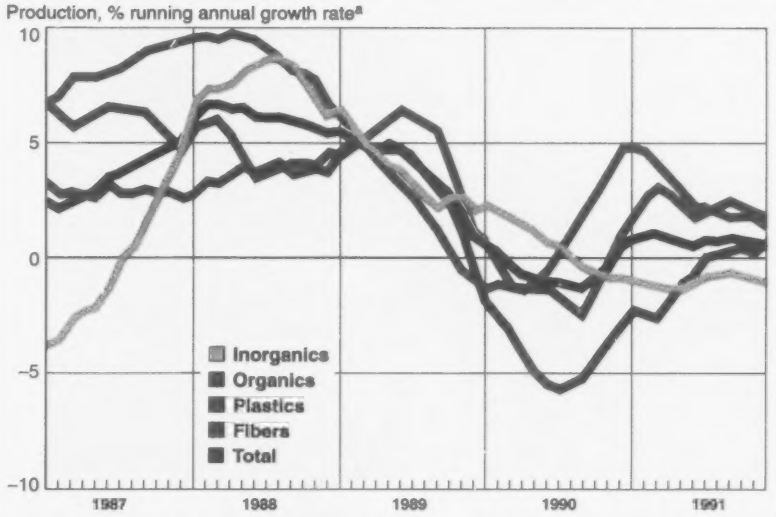
Month-to-month data, however, show the beginnings of recovery toward the end of 1991 and continuing, so far, into 1992. The last three months of 1991 each posted a 3% increase in production over the same month a year earlier, according to Federal Reserve Board data. The early months of 1992 show stronger improvement, with February, March, and April registering 4%, 5%, and 6% gains, respectively, over year-earlier levels.

Thus, by the end of 1991, there were hopeful signs that the long, but relatively mild, recession that had held chemical production levels flat for two years was finally coming to an end.

As was true for chemical output overall for 1991, annual production for major segments of the chemical industry was generally sluggish. Basic chemicals, a subcategory that includes chlor-alkalies, industrial gases, and other industrial inorganic chemicals, gained 3% for the year, according to the Federal Reserve Board. Production of inorganics in C&EN's Top 50 actually fell 1% for the year, but for organic chemicals in the Top 50, output increased a modest 2%.

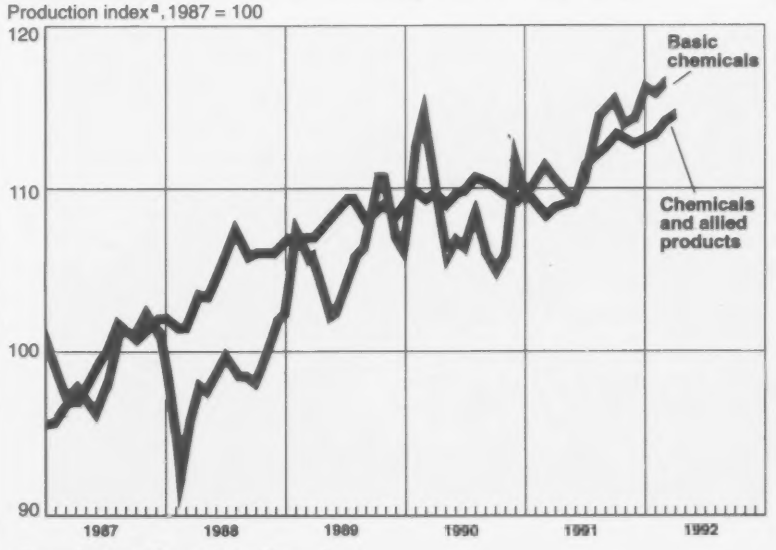
Plastics output rose 3% in 1991, well below 1990's 8% gain and trailing its average annual gain of 5% over the past 10 years. Synthetic fibers posted a 1% gain for the year, thanks mostly to a partial recovery in the polyester fiber market, following a particularly bad showing in 1990. Synthetic rubber production did poorly in 1991, dropping 4% from 1990, making 1991 the third consecutive year of declining production. Fertilizer use slipped 2% in the 1991 crop year, which ended last June.

Output growth dampened for all chemical sectors



[a] Average running annual growth rates in production of major plastics, inorganic and organic chemicals, and all chemicals, and in shipments of man-made fibers. **Sources:** International Trade Commission, Bureau of the Census, Society of the Plastics Industry, Textile Economics Bureau

Chemical production resumed growth late last year



[a] Seasonally adjusted. **Source:** Federal Reserve Board

TOP 50 CHEMICALS: Output was 633 billion lb last year, barely budging from 1990

Rank 1991	Rank 1990[a]		Billions of lb 1991	Billions of lb 1990
1	1	Sulfuric acid	86.62	88.09
2	2	Nitrogen	57.03	56.23
3	4	Ethylene	39.23	36.47
4	3	Oxygen	38.99	40.48
5	6	Ammonia	34.04	33.59
6	5	Lime[b]	33.60	34.90
7	7	Phosphoric acid	24.68	24.07
8	8	Sodium hydroxide	24.39	24.06
9	9	Chlorine	22.65	23.62
10	10	Propylene	22.02	21.85
11	11	Sodium carbonate[c]	20.50	20.18
12	12	Urea[d]	16.14	16.24
13	13	Nitric acid	15.05	16.00
14	14	Ammonium nitrate[e]	14.62	14.16
15	15	Ethylene dichloride	13.92	13.85
16	16	Benzene	11.78	12.45
17	17	Vinyl chloride	11.70	10.63
18	18	Carbon dioxide[f]	9.76	10.37
19	19	Methyl *tert*-butyl ether	9.60	8.89
20	20	Ethylbenzene	9.22	8.37
21	22	Styrene	9.01	8.02
22	21	Methanol	8.65	8.35
23	23	Terephthalic acid[g]	7.66	7.77
24	25	Toluene[h]	6.80	6.21
25	24	Formaldehyde[i]	6.43	6.72
26	25	Xylene[j]	6.13	6.21
27	27	Hydrochloric acid	5.60	6.03
28	29	*p*-Xylene	5.43	5.20
29	28	Ethylene oxide	5.24	5.36
30	31	Ethylene glycol	4.93	5.07
31	30	Ammonium sulfate	4.46	5.08
32	32	Cumene	4.28	4.31
33	33	Potash[k]	3.90	3.78
34	34	Acetic acid	3.61	3.75
35	35	Phenol[l]	3.49	3.54
36	36	Butadiene[m]	2.91	3.09
37	40	Propylene oxide	2.75	2.60
38	37	Carbon black	2.72	2.87
39	38	Acrylonitrile	2.65	2.68
39	39	Vinyl acetate	2.65	2.66
41	42	Aluminum sulfate	2.36	2.45
42	41	Cyclohexane	2.31	2.46
43	44	Titanium dioxide	2.19	2.15
44	43	Acetone	2.13	2.33
45	45	Sodium silicate	1.79	1.76
46	46	Adipic acid	1.56	1.62
47	47	Sodium sulfate[n]	1.54	1.57
48	48	Isopropyl alcohol	1.30	1.38
49	50	Calcium chloride[o]	1.29	1.38
50	49	Caprolactam	1.28	1.38
		TOTAL ORGANICS	224.82	219.45
		TOTAL INORGANICS	407.77	412.82
		GRAND TOTAL	632.59	632.27

a Revised. b Except refractory dolomite. c Natural and synthetic. d 100% basis. e Original solution. f Liquid and solid only. g Includes both acid and ester without double counting. h All grades. i 37% by weight. j Mixed, all uses. k K_2O basis. l Synthetic only. m Rubber grade. n High and low purity. o 75% basis, solid and liquid.

PRODUCTION: Slight increases for some chemicals amid declines in manufacturing overall

Industrial production indexes, 1987 = 100	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	% annual change 1990–91	% annual change 1981–91
Total index	107.1	109.2	108.1	105.4	100.0	95.3	94.4	92.8	84.9	81.9	85.7	–2%	2%
Manufacturing, total	107.4	109.9	108.9	105.8	100.0	94.3	91.6	89.3	80.9	76.6	80.3	–3	3
Nondurable manufacturing	107.9	107.8	106.4	103.6	100.0	94.9	91.5	90.8	87.0	82.5	84.5	0	3
Chemicals and products	110.9	110.3	108.5	105.4	100.0	94.6	91.4	91.4	87.5	81.8	89.2	0	2
Chemicals and synthetic materials	106.8	107.2	106.5	102.5	100.0	93.9	92.2	92.8	88.6	79.4	91.2	0	2
Basic chemicals	111.9	108.6	106.6	98.3	100.0	95.1	96.1	96.9	92.1	86.5	96.9	3	2
Alkalies and chlorine	96.3	99.5	103.2	96.0	100.0	92.1	93.6	95.3	87.9	82.1	94.6	–3	0
Industrial gases	111.9	109.2	108.0	104.1	100.0	98.8	92.8	97.5	85.9	80.1	91.2	2	2
Inorganic pigments	103.9	104.3	111.0	102.6	100.0	96.2	95.1	89.0	87.3	79.1	90.7	0	1
Inorganic chemicals, nec	115.0	110.1	105.7	96.4	100.0	94.7	97.2	98.0	94.3	89.2	98.7	4	2
Industrial organic chemicals	na	107.1	109.2	103.1	100.0	95.1	94.1	93.4	89.9	81.0	97.0	na	na
Synthetic materials	108.5	106.5	103.1	104.4	100.0	91.6	86.9	88.9	84.3	71.8	79.5	2	3
Plastics materials	120.0	115.8	106.7	106.8	100.0	88.2	84.1	81.1	74.4	64.4	68.3	4	6
Synthetic rubber	84.1	88.6	92.4	105.0	100.0	109.3	114.4	132.8	124.1	110.5	114.5	–5	–3
Man-made fibers	92.0	92.7	98.7	99.5	100.0	93.7	86.6	93.3	92.3	76.4	91.7	–1	0
Chemical products	114.7	113.3	110.1	107.5	100.0	95.9	90.2	89.0	86.6	83.0	85.4	1	3
Drugs and medicines	122.0	114.0	108.1	107.2	100.0	96.7	88.5	86.9	86.1	82.7	80.9	7	4
Soaps and toiletries	107.6	112.3	111.1	107.9	100.0	96.7	91.3	90.6	91.4	89.2	97.7	–4	0
Paints	90.0	99.5	104.8	103.0	100.0	97.5	95.7	91.8	84.6	78.8	84.1	–9	1
Agricultural chemicals	105.3	105.1	108.2	107.2	100.0	88.5	96.1	102.0	87.5	88.8	102.3	0	0
Petroleum products	107.5	108.2	106.1	103.4	100.0	98.9	92.6	92.8	89.6	89.3	94.1	–1	1
Rubber and plastics products	110.0	110.2	108.9	105.9	100.0	90.8	85.8	83.8	74.3	65.9	66.6	0	5

na = not available. **nec** = not elsewhere classified. **Source:** Federal Reserve Board

ORGANIC CHEMICALS: Ethylene, vinyl chloride post gains amid general downturn

Millions of lb unless otherwise noted	Production											% annual change	
	1991[a]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
Acetic acid, synthetic	3,612	3,751	3,294	3,159	3,246	2,728	2,897	2,619	2,807	2,748	2,705	–4%	3%
Acetone	2,130	2,329	2,524	2,303	1,846	1,910	1,788	1,862	1,859	1,694	2,144	–9	0
Acrylonitrile	2,647	2,676	2,609	2,452	2,182	2,349	2,219	2,146	2,035	1,997	–1	–1	3
Aniline	996	989	1,016	1,029	829	824	716	786	663	557	634	1	5
Benzene, mg[b,c]	1,605	1,699	1,631	1,608	1,575	1,362	1,283	1,318	1,232	1,052	1,308	–6	2
Bisphenol A	1,181	1,149	1,241	1,340	1,000	956	949	762	643	480	555	3	8
1,3-Butadiene[d]	2,912	3,088	3,121	3,169	2,931	2,546	2,340	2,452	2,353	1,915	2,986	–6	0
1-Butanol	1,314	1,269	1,751	1,104	1,155	881	716	908	833	730	809	4	5
Caprolactam	1,284	1,379	1,307	1,261	1,156	1,109	1,089	1,027	977	793	928	–7	3
Carbon tetrachloride	na	413	na	761	672	627	646	713	573	587	726	—	—
Chloroform	na	484	588	524	462	422	275	405	362	299	405	—	—
Cumene	4,284	4,311	4,426	4,455	4,105	3,745	2,627	3,754	3,345	2,743	3,309	–1	3
Cyclohexane	2,308	2,460	2,273	2,297	2,276	2,070	1,657	1,994	1,656	1,275	1,820	–6	2
Dioctyl phthalate	na	310	306	344	343	296	275	301	300	266	304	—	—
Ethanol, synthetic	na	546	549	562	574	529	649	1,060	1,077	1,023	1,317	—	—
Ethanolamines[e]	642	727	667	608	627	543	537	504	468	416	429	–12	4
Ethylbenzene	9,219	8,369	9,235	9,929	9,346	9,020	7,386	7,562	7,876	6,656	7,813	10	2
Ethyl chloride	na	149	162	152	155	164	171	290	282	339	324	—	—
Ethylene	39,224	36,467	34,988	37,204	34,951	32,859	29,847	31,383	28,680	24,501	29,418	8	3
Ethylene dichloride	13,919	13,849	13,383	13,028	12,197	12,940	12,101	10,710	11,506	7,619	9,974	1	3
Ethylene glycol	4,930	5,070	5,461	5,517	5,183	4,771	4,178	4,823	4,425	4,309	4,143	–3	2
Ethylene oxide	5,243	5,355	5,031	5,953	4,785	5,430	5,430	5,699	5,534	4,987	4,937	–2	1
2-Ethylhexanol	641	650	612	743	662	571	536	541	387	325	389	–1	5
Formaldehyde, 37%[f]	6,424	6,720	5,893	6,280	5,733	5,549	5,606	5,815	5,465	4,817	5,721	–4	1
Isobutylene	1,104	1,212	1,193	1,244	1,035	1,124	na	883	760	741	1,035	–9	1
Isopropyl alcohol	1,296	1,456	1,474	1,389	1,371	1,301	1,235	1,394	1,209	1,380	1,669	–11	–2
Maleic anhydride	382	424	475	448	382	359	394	359	299	260	293	–10	3
Methanol, synthetic	8,654	8,344	8,167	8,142	7,537	7,205	5,003	8,186	7,982	7,555	8,577	4	0
Methyl *tert*-butyl ether	9,600[g]	8,884	8,227	5,680	3,514	3,375	1,891	1,376	839	824	760	8	29
Methyl chloride	784	772	461	597	373	605	410	482	409	366	405	2	7
Methyl ethyl ketone	523	465	450	482	672	600	537	543	531	468	614	12	–2
Methyl methacrylate	1,102	1,182	1,161	1,100	1,029	943	858	917	844	721	592	–7	6
Methylchloroform	649	803	783	724	694	652	869	675	586	595	611	–19	1
Methylene chloride	389	461	482	504	516	566	467	607	584	532	891	–16	–8
Perchloroethylene	240	372	481	498	473	414	678	573	547	585	691	–35	–10
Phenol, synthetic[h]	3,484	3,538	3,806	3,562	3,351	3,115	2,841	2,889	2,638	2,023	2,578	–2	3
Phthalic anhydride	874	940	917	999	1,035	863	820	870	838	684	870	–7	0
Propylene[i]	22,019	21,846	20,571	21,224	19,019	16,522	14,887	15,559	13,959	12,535	13,482	1	5
Propylene glycol	745	754	805	840	747	573	500	462	484	400	473	–2	5
Styrene	9,003	8,017	8,337	8,984	8,014	7,888	7,622	7,709	6,802	5,942	6,679	12	3
Terephthalic acid, dimethyl ester[j]	7,654	7,773	8,426	10,234	7,601	6,257	6,490	5,912	5,626	4,843	6,235	–2	2
Toluene, mg[b,k]	940	861	806	892	967	611	698	728	780	714	852	9	1
Vinyl acetate	2,645	2,659	2,552	2,561	1,813	1,710	2,112	2,024	1,963	1,876	1,936	–1	3
Vinyl chloride	11,694	10,623	10,135	9,058	8,402	8,439	9,463	6,084	6,875	4,902	6,874	10	5
***o*-Xylene**	935	943	983	971	940	788	675	688	781	802	918	–1	0
***p*-Xylene**	5,432	5,200	5,344	5,601	5,155	5,035	4,779	4,264	4,114	3,391	4,532	4	2

Note: mg = millions of gallons. a Preliminary. b Tar distillers and coke-oven operators not included. c Specification grades. d Rubber grade. e Mono-, di-, and triethanolamines. f By weight. g C&EN estimate. h Does not include data for coke ovens and gas-retort ovens. i All grades. j Includes both acid and dimethyl ester (DMT), without double counting. k High-purity toluene, includes material used in blending motor fuel. na = not available. **Source:** International Trade Commission

INORGANIC CHEMICALS: Mixed picture includes more declines than increases

Thousands of tons unless otherwise noted	Production											% annual change	
	1991[a]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
Aluminum sulfate[b]	1,180	1,227	1,243	1,237	1,227	1,222	1,268	1,129	1,119	1,154	1,294	–4%	–1%
Ammonia, 100%[c,d]	17,020	16,796	16,468	16,821	16,098	14,487	17,319	16,692	14,072	15,801	19,044	1	–1
Ammonium nitrate, 100%[e]	7,310	7,081	7,871	7,504	6,547	6,091	7,149	7,146	6,240	7,091	8,861	3	–2
Ammonium sulfate, 100%[d,f]	2,230	2,539	2,384	2,333	2,189	2,080	2,093	2,067	1,956	1,768	2,185	–12	0
Chlorine gas[g]	11,324	11,810	11,413	11,257	11,078	10,436	10,402	10,700	9,960	9,176	10,763	–4	1
Hydrochloric acid, 100%[h]	2,799	3,013	3,268	3,228	2,996	2,413	2,807	2,732	2,468	2,450	2,574	–7	1
Hydrogen, bcf, 100%[i,j]	142	148	146	177	173	136	121	109	103	88	105	–4	3
Hydrogen peroxide, 100%[k]	263	238	204	168	153	152	144	139	117	108	111	11	9
Nitric acid, 100%[h]	7,524	7,999	8,349	7,991	7,225	6,734	7,631	7,726	6,768	7,390	9,093	–6	–2
Nitrogen gas, bcf, 100%[i,l]	787	749	744	722	685	677	665	661	560	483	490	5	5
Oxygen, bcf, 100%[i,l]	471	462	460	452	405	383	393	375	346	349	431	2	1
Phosphoric acid, 100% P_2O_5	12,342	12,034	11,737	11,659	10,599	9,578	10,607	11,370	9,767	8,253	9,958	3	2
Phosphorus[m]	312	346	353	343	344	364	359	386	366	361	426	–10	–3
Sodium chlorate, 100%	457	317	290	267	289	267	259	295	323	291	297	44	4
Sodium hydroxide, 100%	12,197	12,030	11,470	10,533	11,553	10,691	10,811	10,914	10,039	9,385	10,621	1	1
Sodium phosphate[n]	445	496	610[o]	549	586	617	625	675	669	651	696	–10	–4
Sodium silicate[p]	894	816	833	812	952	791	692	585	710	664	771	10	2
Sodium sulfate, 100%[q]	767	786	755	819	799	837	1,203	901	914	864	1,111	–2	–4
Sulfuric acid, 100%[r]	43,308	44,044	43,301	42,580	39,256	35,993	39,890	41,802	36,583	33,233	40,742	–2	1
Titanium dioxide, 100%[s]	1,093	1,077	1,101	1,022	968	931	860	835	760	660	761	1	4
Urea	8,072	8,120	8,004	7,914	7,433	6,264	6,975	7,433	6,137	6,470	8,062	–1	0

Note: bcf = billions of cubic feet. **a** Preliminary. **b** Commercial, 17% Al_2O_3; includes municipalities. **c** Synthetic anhydrous. **d** Excludes by-product ammonia liquor and ammonium sulfate. **e** Original solution. **f** Synthetic and noncoke by-product. **g** Includes quantities liquefied for use, storage, or shipment. **h** Includes anhydrous hydrochloric acid production. **i** High- and low-purity gas. **j** Liquid and gas; excludes amounts vented and used as fuel, and amounts produced in petroleum refineries for captive use. **k** Includes unspecified amounts produced but not withdrawn from the system. **l** Excludes amounts produced and consumed in making synthetic ammonia or ammonia derivatives. **m** Elemental, white (yellow), and red. **n** Tripolyphosphate (100% $Na_5P_3O_{10}$). **o** Includes tetrabasic (pyro) phosphate. **p** Soluble silicate glass (water glass), solid and liquid (anhydrous); excludes amounts produced and consumed in making meta-, ortho-, and sesquisilicates. **q** Anhydrous, high and low purity, and Glauber's salt. **r** Gross (new and fortified). **s** Composite and pure. **Sources:** Department of Commerce, International Trade Commission

MINERALS: For most minerals, 1991 was second year of declining production

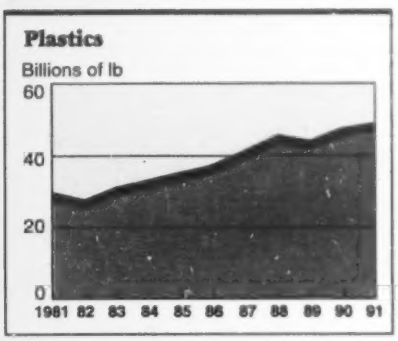
Thousands of tons	1991[a]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	% annual change 1990–91	% annual change 1981–91
Bromine, sold or used[b]	187	195	193	180	168	155	160	193	185	200	189	–4%	0%
Calcium chloride, production[c]	644[d]	690[d]	801[d]	731	658	780	940	1,036	912	853	917	–7	–3
Lime, production[e]	16,800[d]	17,452	17,152	17,052	15,733	14,474	15,690	15,922	14,867	14,075	18,890	–4	–1
Lithium, consumption[d,f]	2.9	3.0	3.0	3.0	2.6	2.6	2.5	3.2	2.2	2.0	3.2	–3	–1
Phosphate rock													
Production	53,016	51,084	54,913	50,032	45,144	44,445	56,035	54,230	46,928	41,241	59,110	4	–1
Exports	5,768	6,876	8,644	8,920	9,319	8,651	10,071	12,707	13,239	10,849	11,458	–16	–7
Potash (K_2O equivalent)[g]													
Production	1,951[d]	1,888	1,758	1,677	1,391	1,325	1,429	1,724	1,575	1,967	2,377	3	–2
Imports	4,630[d]	4,590	3,758	4,648	4,490	4,643	5,063	5,323	4,894	4,253	5,287	1	–1
Apparent consumption[h]	5,890[d]	6,011	4,960	5,803	5,609	5,338	5,893	6,638	6,231	5,647	6,849	–2	–2
Sodium carbonate, production[i]	9,926	10,093	9,915	9,632	8,891	8,438	8,511	8,511	8,467	7,819	8,281	–2	2
Sulfur, production[j]	11,847	12,743	12,778	11,845	11,616	12,221	12,797	11,742	10,240	10,788	13,388	–7	–1
Recovered elemental	7,362	7,205	7,176	7,103	6,791	6,411	5,857	5,747	5,462	4,855	4,695	2	5
Frasch	3,162	4,107	4,286	3,499	3,530	4,457	5,524	4,622	3,530	4,641	6,997	–23	–3
Other production	1,323[d]	1,431	1,316	1,243	1,296	1,354	1,416	1,372	1,249	1,293	1,695	–7	–2
Apparent consumption[h]	13,669	14,392	13,983	14,012	12,481	11,669	13,192	13,976	12,112	11,088	14,093	–5	0

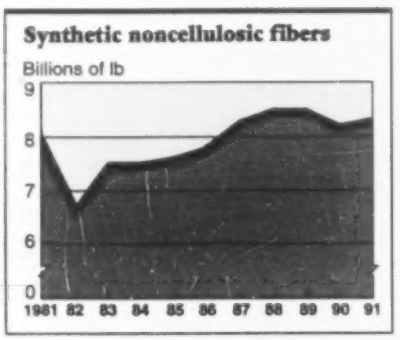
a Preliminary data, except those for phosphate rock. **b** Elemental bromine sold as such or used in preparation of bromine compounds by primary producers. **c** 75% $CaCl_2$ equivalent. **d** Estimated. **e** Sold or used by producers for commercial or captive use. Produced from limestone and dolomite, does not include amount regenerated by paper industry; excludes Puerto Rican production. **f** Lithium content basis. **g** Includes muriate and sulfate of potash, potassium magnesium sulfate, and parent salts; excludes other chemical compounds containing potassium. **h** Calculated from shipments plus imports minus exports. **i** Natural and synthetic for 1980–86, natural only in 1987–90. **j** Sulfur content basis. **Sources:** Bureau of Mines, Bureau of the Census

PLASTICS: Increases for major thermoplastics buoyed resin production last year

Millions of lb[a]	Production											% annual change	
	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
THERMOSETTING RESINS													
Epoxy[b]	531	499	509	486	433	398	385	406	334	286	336	6%	5%
Melamine	196	202	222	207	212	173	192	210	180	158	179	–3	1
Phenolic[c,d]	2,658	2,946	2,879	3,066	2,869	2,735	2,621	2,502	2,477	2,006	2,333	–10	1
Polyester[e]	1,075	1,221	1,319	1,404	1,367	1,271	1,223	1,232	1,084	865	997	–12	1
Urea	1,483	1,496	1,477	1,425	1,382	1,271	1,210	1,199	1,172	998	1,165	–1	2
TOTAL	**5,943**	**6,364**	**6,408**	**6,588**	**6,263**	**5,848**	**5,631**	**5,549**	**5,247**	**4,313**	**5,010**	**–7**	**2**
THERMOPLASTIC RESINS													
Polyethylene													
Low density[f]	11,580	11,148	9,695	10,397	9,599	8,903	8,889	8,413	8,041	7,503	7,693	4	4
High density[g]	9,216	8,337	8,102	8,400	7,995	7,182	6,671	6,085	5,669	4,928	4,695	11	7
Polypropylene	8,335	8,310	7,238	7,274	6,647	5,812	5,139	4,940	4,433	3,477	3,955	0	8
Styrene polymers													
Polystyrene	4,956	5,021	5,104	5,187	4,780	4,470	4,054	3,838	3,570	3,191	3,621	–1	3
Styrene-acrylonitrile	109	135	113	148	126	92	87	99	93	91	107	–19	0
Acrylonitrile-butadiene-styrene and other styrene polymers[h]	2,289	2,351	2,394	2,418	2,254	2,196	2,036	2,127	1,889	1,380	1,745	–3	3
Polyamide, nylon type	576	558	569	566	507	465	399	396	321	228	312	3	6
Vinyl resins													
Polyvinyl chloride and copolymers	9,168	9,096	8,478	8,350	7,971	7,256	6,772	6,760	6,067	5,326	5,707	1	5
Other vinyl resins[i]	190	212	220	222	212	195	190	187	186	177	208	–10	–1
Thermoplastic polyester	2,109	1,879	1,630	1,652	1,394	1,175	965	899	778	648	609	12	13
TOTAL	**48,529**	**47,047**	**43,543**	**44,614**	**41,485**	**37,746**	**35,202**	**33,744**	**31,067**	**26,949**	**28,652**	**3%**	**5%**

Note: Totals are for those products listed and exclude some small-volume plastics. **a** Dry-weight basis unless otherwise specified. **b** Unmodified. **c** Includes other tar acid resins. **d** Gross-weight basis. **e** Unsaturated; estimate. **f** Density 0.940 and below. **g** Density above 0.940. **h** Includes styrene-butadiene copolymers and other styrene-based polymers. **i** Includes polyvinyl butyral, polyvinyl formal, and polyvinylidene-chloride. **Source:** Society of the Plastics Industry





SYNTHETIC FIBERS: Gains in polyester, polyolefins help fibers recover

Millions of lb	Production											% annual change	
	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
NONCELLULOSIC FIBERS													
Acrylic[a]	454	506	543	588	592	616	631	671	671	624	691	–11%	–4%
Nylon[b]	2537	2662	2740	2669	2689	2514	2343	2412	2419	1927	2332	–5	1
Olefin[c]	1865	1822	1639	1588	1494	1393	1249	997	906	723	785	2	9
Polyester	3410	3195	3594	3681	3541	3305	3341	3392	3544	3196	4176	7	–2
CELLULOSIC FIBERS													
Acetate[d]	486	505	580	614	605	619	559	199	229	196	261	–4	–5
Rayon								421	401	388	509		
TOTAL	**8752**	**8690**	**9096**	**9140**	**8921**	**8447**	**8122**	**8092**	**8168**	**7027**	**8754**	**1%**	**0%**

a Includes modacrylic. **b** Excludes aramid since 1982. **c** Includes olefin yarn and monofilaments and olefin and vinyon staple, tow, and fiberfill. **d** Includes diacetate and triacetate; excludes production for cigarette filters. **Source:** Fiber Economics Bureau

SYNTHETIC RUBBER: Output in 1991 was down for third consecutive year

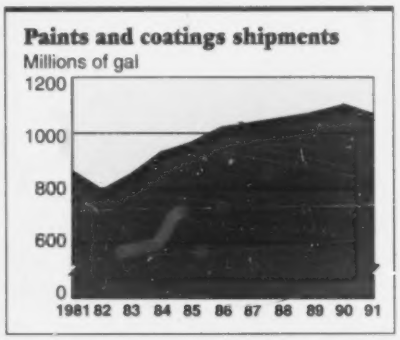
Thousands of metric tons	Production											% annual change	
	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
Ethylene-propylene	232	266	260	263	254	230	215	215	175	123	178	–13%	3%
Nitrile	57	56	70	76	69	59	53	67	55	45	66	0	–1
Polybutadiene	415	412	452	407	371	336	330	359	333	288	342	–1	2
Styrene-butadiene rubber	843	853	884	909	850	792	735	958	904	876	1032	–1	–2
Other[a]	668	725	662	679	638	596	505	556	468	498	404	–8	5
TOTAL	**2215**	**2312**	**2328**	**2334**	**2182**	**2013**	**1838**	**2155**	**1935**	**1830**	**2022**	**–4%**	**1%**

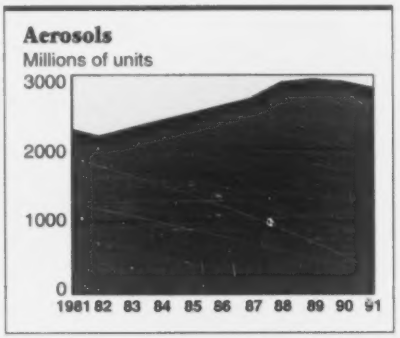
a Includes butyl, polychloroprene, polyisoprene, silicone, and other synthetic elastomers. Some values are estimated. **Sources:** International Institute of Synthetic Rubber Producers; Rubber Manufacturers Association

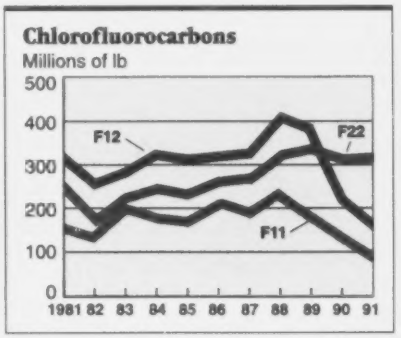
PAINTS AND COATINGS: Shipments slip after nearly a decade of rising steadily

Millions of gal	Shipments											% annual change	
	1991[a]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
Architectural	521	557	537	536	527	498	478	457	433	374	417	–6%	2%
Product[b]	361	346	360	364	340	368	352	336	294	280	312	4	2
Special purpose	168	197	179	154	146	135	145	145	130	129	129	–15	1
TOTAL	**1050**	**1100**	**1076**	**1054**	**1013**	**1001**	**975**	**938**	**857**	**783**	**858**	**–5%**	**1%**

a Preliminary. b For original equipment manufacturers. **Source:** Department of Commerce







AEROSOLS: Decline in personal product uses drops production for second year

Millions of units	Production[a]											% annual change	
	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
Personal products	905	1050	1015	1100	964	952	879	832	747	628	645	–3%	3%
Household products	690	680	680	650	640	635	630	603	586	556	575	1	2
Automotive and industrial products	450	415	475	440	379	375	342	337	303	286	302	8	4
Paints and finishes	350	350	350	331	307	297	290	307	300	295	313	0	1
Insect sprays	200	190	197	190	190	193	190	184	180	166	173	5	2
Food products	192	175	175	157	140	136	140	138	132	131	145	10	3
Animal products	8	8	8	8	22	22	15	16	19	19	14	0	–5
Miscellaneous	19	15	12	31	80	18	23	15	15	13	28	27	4
TOTAL	**2814**	**2883**	**2912**	**2907**	**2722**	**2628**	**2509**	**2432**	**2282**	**2094**	**2195**	**–2%**	**3%**

a Includes Puerto Rico. **Source:** Chemical Specialties Manufacturers Association

CHLOROFLUOROCARBONS: Production of nonhydrogenated CFCs fell 27% last year

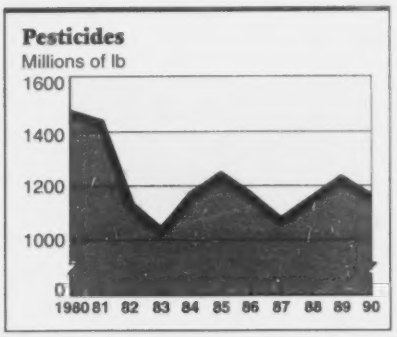
Millions of lb	Production											% annual change	
	1991[a]	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
Chlorodifluoromethane (CFC-22)	309[b]	306	343	333	275	271	235	254	236	174	252	1%	2%
Dichlorodifluoromethane (CFC-12)	153	209	392	414	335	322	302	337	290	258	325	–27	–3
Trichlorofluoromethane (CFC-11)	99	135	192	249	198	202	176	185	215	140	163	–27	–3
All other fluorinated hydrocarbons[c]	na	na	385	379	354	344	306	337	279	na	na	—	—
TOTAL	**na**	**na**	**1312**	**1374**	**1162**	**1139**	**1019**	**1113**	**1020**	**na**	**na**	**—**	**—**

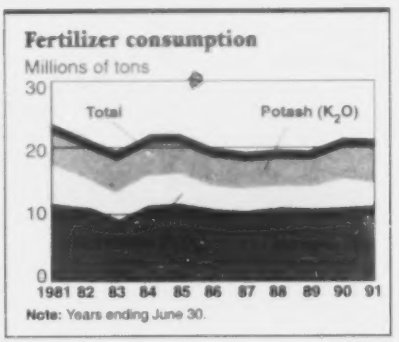
a Preliminary. b C&EN estimate. c Includes other fluorohalogenated hydrocarbons. **na** = not available. **Source:** International Trade Commission

PESTICIDES: Stalled growth ends decade that never recovered from early 1980s tumble

Millions of lb	Production											% annual change	
	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1989–90	1980–90
Herbicides[a]	698	697	702	556	725	756	716	604	623	839	806	0%	–1%
Insecticides[b]	386	424	352	379	342	370	350	306	379	448	506	–9	–7
Fungicides[c]	96	111	110	105	113	109	123	106	111	143	156	–14	–5
TOTAL	**1180**	**1232**	**1164**	**1040**	**1180**	**1235**	**1189**	**1017**	**1113**	**1430**	**1468**	**–4%**	**–2%**

a Includes plant growth regulators. b Includes rodenticides, soil conditioners, and fumigants. c Includes dithiocarbamates. **Source:** International Trade Commission





Note: Years ending June 30.

FERTILIZER CONSUMPTION: Nitrogen is only major nutrient whose use was up last year

Thousands of tons	Consumption											% annual change	
	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
Nitrogen (N)	11,179	11,076	10,593	10,512	10,210	10,424	11,493	11,092	9,127	10,983	11,924	1%	–1%
Phosphates (P_2O_5)	4,151	4,345	4,117	4,129	4,008	4,178	4,658	4,901	4,138	4,814	5,434	–4	–3
Potash (K_2O)	4,984	5,203	4,838	4,973	4,837	5,053	5,553	5,797	4,831	5,631	6,320	–4	–2
TOTAL	**20,314**	**20,624**	**19,548**	**19,614**	**19,055**	**19,655**	**21,704**	**21,790**	**18,096**	**21,428**	**23,678**	**–2%**	**–2%**

Note: Years ending June 30. **Source:** Fertilizer Institute

FERTILIZER PRODUCTION: Ammonia was flat, most other fertilizers declined in 1991

Thousands of tons	1991	1990	1989	1988	1987	1986	1985	1984	1983	% annual change 1990–91	% annual change 1983–91
NITROGEN PRODUCTS											
Ammonia	14,191	14,167	14,192	14,136	13,357	12,565	16,594	16,613	13,361	0%	1%
Ammonium nitrate	2,551	2,579	2,528	2,765	2,472	2,250	3,178	3,365	3,232	–1	–2
Ammonium sulfate	2,199	2,395	2,327	2,260	2,153	2,058	2,343	2,078	1,969	–8	2
Urea	4,258	4,231	4,253	4,501	4,253	3,564	3,975	4,889	4,112	1	0
Nitrogen solutions	na	4,750	5,644	6,999	5,988	5,945	7,928	7,999	6,385	na	na
PHOSPHATE PRODUCTS											
Diammonium phosphate	13,569	13,860	13,507	11,575	9,537	7,492	10,800	12,358	10,264	–2	3
Monoammonium phosphate	2,219	2,252	1,991	1,818	1,679	1,416	1,641	1,654	1,423	–2	5
Concentrated superphosphate	1,914	1,998	1,777	2,032	2,049	2,127	2,570	2,404	2,684	–4	–3
Phosphate rock	44,877	44,311	47,676	42,220	39,330	36,227	49,348	47,465	40,664	1	0
Phosphoric acid (P_2O_5)	10,913	11,344	10,962	10,234	8,903	8,085	9,837	10,899	9,182	–4	2
POTASH PRODUCTS											
Potassium chloride	2,387	2,350	2,316	2,243	1,810	1,715	1,713	2,168	1,928	2	2

Note: Figures are based on Fertilizer Institute surveys and may not represent the entire industry. **na**=not available. **Source:** Fertilizer Institute

Poor showing for chemical makers

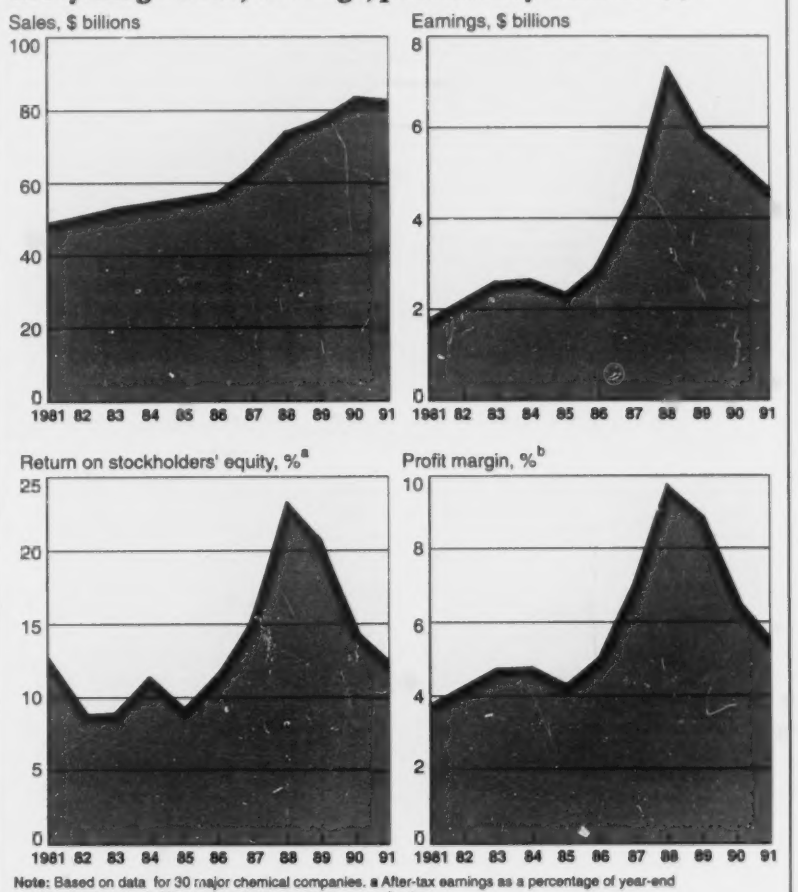
Poor financial results characterized chemical performance in 1991. Sales, earnings, and profitability all fell from 1990 levels. These results came as little surprise to industry analysts who had forecast a slow first half for 1991 with something of a rebound coming sometime in the second six months. To a certain degree, that forecast came true. However, whereas some companies saw an upturn, especially in the fourth quarter, the improvement was not widespread enough nor strong enough to counter the drop that had occurred earlier in the year.

Although growth in demand could only be described as lackluster in 1991, the real culprit in declining financial results was pricing. The value of shipments of chemicals and allied products in 1991 increased less than 1% over the previous year, but for industrial chemicals, which account for most of the fortunes of the traditional chemical industry, the value of shipments fell almost 3%. The government's producer price index for chemicals and allied products rose about 1.6% through 1991, but the index for industrial chemicals dropped about 7%.

The result of the declining demand and prices was, naturally, falling fortunes within the industry. For the 30 companies C&EN regularly surveys, which produce mostly industrial chemicals, sales fell about 1% to $82.4 billion. At the same time, earnings dropped 16% to $4.47 billion, their lowest level since 1987 and their third straight year of decline. Profitability for the group declined to its lowest level since 1986: Earnings as a percentage of sales fell to 5.3% in 1991 from 6.4% the year before, and earnings as a percentage of stockholders' equity declined to 12.1% last year from 14.1% the year before.

In 1991 all measures of profitability showed enormous declines from the recent highs set in 1988. Profit margins (earnings as a percentage of sales) dropped from 9.5% to 5.3% while earnings as a percent of stockholders' equity fell by almost a half from 23% to 12%.

Everything—sales, earnings, profitability—fell in 1991



Note: Based on data for 30 major chemical companies. a After-tax earnings as a percentage of year-end stockholders' equity. b After-tax earnings as a percentage of sales.

Last year's results were helped by a good balance of trade. The value of exports rose about 10% and the value of imports increased less than 8%, leading to a 14% increase in the chemical trade surplus for 1991. Here again, though, prices had a moderating effect. In some cases—notably plastics—sales volume grew significantly over the year before, but the prices of materials sold abroad often did not match U.S. prices. Thus, the value of exports didn't increase as much as did their physical volume.

If there is anything hopeful to be seen in 1991, it may be that by the end of the year, although the 30 chemical companies as a group were still suffering from declining earnings, most of this decline was accounted for by only a few commodity-producing companies. For instance, in the fourth quarter, only seven of the 30 companies reported earnings declines from fourth-quarter 1990. This trend has continued into 1992, when in the first quarter, 24 of the companies reported earnings improvement over the like period of 1991.

TOP 100 CHEMICAL PRODUCERS: Nearly half saw chemical sales drop last year

Rank 1991	Rank 1990		Chemical sales 1991 ($ millions)	Change from 1990	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1990	Chemical operating profits as % of total profits	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
1	1	Du Pont	$15,383	−1.2%	39.8%	Diversified	$1265	−35.7%	36.2%	8.2%	$13,505	42.4%	9.4%
2	2	Dow Chemical	13,277	−9.6	70.6	Basic chemicals	835	−56.6	40.7	6.3	13,460	54.4	6.2
3	3	Exxon	10,703	−4.0	9.3	Petroleum	672	−8.8	7.6	6.3	8,630	9.9	7.8
4	6	Hoechst Celanese	6,347	15.4	93.4	Basic chemicals	488	14.3	103.2	7.7	na	na	na
5	5	Monsanto	5,451	−4.6	61.5	Basic chemicals	694	11.2	68.6	12.7	4,754	51.5	14.6
6	4	Union Carbide	4,877	−6.9	100.0	Basic chemicals	122	−80.4	100.0	2.5	4,761	100.0	2.6
7	7	General Electric	4,722[d]	−8.6	7.8	Diversified	803	−21.0	10.1	17.0	8,340	5.0	9.6
8	8	Occidental Petroleum	4,649	−7.8	40.4	Petroleum	53	−91.7	5.0	1.1	5,150	32.0	1.0
9	9	BASF	3,959	−9.3	79.8	Basic chemicals	na	na	na	na	na	na	na
10	11	Mobil	3,953	−3.2	6.3	Petroleum	245	−38.3	5.2	6.2	3,294	7.8	7.4
11	10	Amoco	3,893	−4.7	13.8	Petroleum	56	−77.8	2.3	1.4	3,858	12.8	1.5
12	13	Eastman Kodak	3,740	4.2	19.3	Photo equipment	538	−10.6	22.6	14.4	4,035	16.7	13.3
13	14	W. R. Grace	3,531	−1.1	58.4	Specialty chemicals	426	−1.2	118.7	12.1	2,677	44.6	15.9
14	12	Shell Oil	3,378	−9.1	15.2	Petroleum	264	−49.1	57.0	7.8	3,989	14.2	6.6
15	15	Chevron	3,098	−6.8	7.7	Petroleum	196	345.5	7.3	6.3	2,612	8.0	7.5
16	16	Arco Chemical	2,837	0.2	100.0	Basic chemicals	398	−15.1	100.0	14.0	3,676	100.0	10.8
17	17	Rohm & Haas	2,763	−2.2	100.0	Basic chemicals	327	−6.8	100.0	11.8	2,495	100.0	13.1
18	19	Air Products[e]	2,676	2.4	91.3	Basic chemicals	474	7.7	108.4	17.7	3,445	90.7	13.8
19	20	Miles	2,479	11.4	40.0	Diversified chemicals	na	na	na	na	na	na	na
20	—	Union Carbide Ind. Gases	2,469	2.0	92.5	Basic chemicals	324	−20.8	100.0	13.1	3,451	100.0	9.4
21	18	Allied-Signal	2,459	−11.7	20.8	Diversified	183	−36.2	32.9	7.4	1,949	18.8	9.4
22	22	American Cyanamid	2,344	4.0	47.0	Basic chemicals	222	13.8	36.7	9.5	1,788	48.2	12.4
23	21	Rhône-Poulenc	2,300	1.0	100.0	Specialty chemicals	na	na	na	na	na	na	na
24	23	Ashland Oil[e]	2,285	1.8	23.2	Petroleum	98	40.0	33.3	4.3	834	15.3	11.8
25	24	Hercules	2,172	−1.0	74.2	Basic chemicals	201	20.4	101.5	9.3	1,913	72.5	10.5
26	26	Ciba-Geigy	2,151	10.0	52.0	Specialty chemicals	na	na	na	na	na	na	na
27	29	Akzo	1,913	1.0	100.0	Basic chemicals	na	na	na	na	na	na	na
28	25	Phillips Petroleum	1,904	−10.2	15.1	Petroleum	297	−33.7	24.0	15.6	1,970	17.2	15.1
29	27	Quantum Chemical	1,885	−3.8	74.4	Basic chemicals	99	−59.3	112.7	5.2	2,219	69.4	4.4
30	33	Dow Corning	1,845	7.4	100.0	Specialty chemicals	na	na	na	na	na	na	na
31	31	Aluminum Co. of America	1,842	0	18.6	Nonferrous metals	535	−59.5	114.7	29.0	2,690	24.8	19.9
32	28	B. F. Goodrich	1,778	−8.3	71.9	Basic chemicals	35	−73.2	49.8	1.9	1,425	67.4	2.4
33	34	National Starch	1,756	5.1	100.0	Specialty chemicals	269	5.9	100.0	15.3	1,635	100.0	16.5
34	35	FMC	1,684	3.7	43.2	Machinery	203	6.0	46.4	12.1	1,455	58.9	14.0
35	30	Lyondell Petrochemical	1,666	−11.8	32.0	Petroleum products	249	−44.4	47.7	14.9	na	na	na
36	36	Ethyl	1,535	−3.5	59.6	Basic chemicals	231	−25.1	59.2	15.0	1,320	16.7	17.5
37	32	Texaco	1,515	−12.1	4.1	Petroleum	4	−93.3	0.3	0.3	1,398	6.7	0.3
38	37	Elf Atochem	1,500	−2.6	100.0	Basic chemicals	na	na	na	na	na	na	na
39	38	Degussa	1,359	−5.2	85.0	Specialty chemicals	na	na	na	na	na	na	na
40	39	Lubrizol	1,349	1.0	91.4	Specialty chemicals	179	−55.0	106.9	13.3	862	73.6	20.8
41	48	Great Lakes Chemical	1,308	22.6	100.0	Specialty chemicals	350	20.8	100.0	26.8	1,649	100.0	21.2
42	44	Nalco Chemical	1,237	2.1	100.0	Specialty chemicals	227	7.6	100.0	18.3	1,324	100.0	17.1
43	50	Morton International[f]	1,215	18.9	63.7	Specialty chemicals	153	9.7	71.4	12.6	1,225	68.8	12.5
44	43	Unocal	1,213	−1.9	11.1	Petroleum	89	−22.6	42.0	7.3	662	6.7	13.4
45	40	Huntsman Chemical	1,200	−7.7	100.0	Basic chemicals	na	na	na	na	na	na	na
46	41	Tenneco	1,160	−10.6	8.5	Diversified	66	−60.5	12.0	5.7	1,443	7.9	4.6
47	47	IMC Fertilizer[f]	1,131	2.3	100.0	Agrochemicals	196	14.6	100.0	17.3	1,739	100.0	11.3
48	46	Cabot[e]	1,129	2.0	76.1	Basic chemicals	103	−29.9	91.6	9.1	1,060	72.5	9.7
49	49	Imcera Group[f]	1,127	10.0	69.0	Specialty chemicals	135	29.1	72.9	11.9	1,124	49.9	12.0
50	45	PPG Industries	1,100	−4.3	19.4	Glass products	195	−15.6	34.3	17.7	1,076	17.8	18.1

CIRCLE 6 ON READER SERVICE CARD →

Rank 1991	Rank 1990		Chemical sales 1991 ($ millions)	Change from 1990	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1990	Chemical operating profits as % of total profits	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
51	54	Farmland Industries[g]	$1036	7.3%	28.5%	Agricultural supplies	$123	47.3%	85.3%	11.9%	$442	38.3%	27.9%
52	56	Inspiration Resources	1023	6.4	96.4	Agrochemicals	35	46.2	82.4	3.4	352	70.4	10.0
53	55	International Flavors	1017	5.6	100.0	Specialty chemicals	254	4.5	100.0	25.0	1217	100.0	20.9
54	52	Solvay America	1010	1.3	100.0	Basic chemicals	na	na	na	na	na	na	na
55	51	Reichhold Chemicals	1000	0.0	100.0	Specialty chemicals	na	na	na	na	na	na	na
56	42	Olin	960	−24.3	42.2	Basic chemicals	na	na	na	na	982	48.8	na
57	60	Freeport-McMoRan	880	6.7	55.8	Agrochemicals	71	37.4	31.7	8.1	1143	32.1	6.2
58	64	H. B. Fuller[h]	853	7.7	100.0	Specialty chemicals	60	15.3	100.0	7.0	509	100.0	11.8
59	53	Aristech	844	−13.3	100.0	Basic chemicals	na	na	na	na	na	na	na
60	58	NL Industries	840	−7.3	100.0	Basic chemicals	139	−44.7	100.0	16.5	1831	100.0	7.6
61	57	Georgia Gulf	838	−10.1	100.0	Basic chemicals	171	−25.4	100.0	20.3	416	100.0	41.0
62	62	Uniroyal Chemical	832	3.0	100.0	Specialty chemicals	102	−5.6	100.0	12.3	1143	100.0	9.0
63	63	Engelhard	809	0.3	33.2	Diversified	111	10.8	69.8	13.7	813	64.7	13.6
64	59	CF Industries	803	−11.1	100.0	Agrochemicals	78	71.2	100.0	9.7	837	100.0	9.3
65	65	Witco[i]	793	3.1	48.6	Specialty chemicals	72	−12.6	52.5	9.0	478	39.9	15.0
66	71	Pfizer	730	−18.1	10.5	Drugs	57	−17.4	5.7	7.8	795	8.3	7.2
67	66	Vista Chemicals[e]	705	−1.9	100.0	Basic chemicals	na	na	na	na	na	na	na
68	—	CBI Industries	698	5.4	43.2	Construction	107	4.3	63.8	15.3	na	na	na
69	61	Fina	667	−18.0	20.5	Petroleum	103	−35.4	87.9	15.5	462	16.1	22.4
70	68	Betz Laboratories	666	11.5	100.0	Specialty chemicals	119	14.3	100.0	17.9	476	100.0	25.06.8
71	70	Merck	583	5.8	6.8	Drugs	78	15.5	2.6	13.4	548	8.6	14.3
72	69	Loctite	561	1.1	100.0	Specialty chemicals	99	0.5	100.0	17.6	529	100.0	18.7
73	73	Sterling Chemical[e]	543	27.0	100.0	Basic chemicals	61	−30.1	100.0	9.4	361	100.0	16.8
74	77	Intl. Specialty Products	526	2.8	100.0	Specialty chemicals	141	5.6	100.0	26.7	na	na	na
75	78	Hüls	500	7.5	100.0	Specialty chemicals	na	na	na	na	na	na	na
76	80	Sigma-Aldrich	498	13.2	84.5	Specialty chemicals	119	14.9	96.0	23.9	529	88.7	22.5
77	72	Ferro	476	−7.2	45.0	Specialty materials	9	−8.0	12.2	1.9	248	44.9	3.7
78	79	Union Camp	471	2.3	15.9	Diversified	27	20.3	9.7	5.7	358	7.6	7.5
79	67	Kerr-McGee	454	−29.3	13.9	Petroleum	101	−17.9	37.8	22.2	755	24.2	13.4
80	—	Rexene	450	−10.4	100.0	Basic chemicals	12	−85.2	100.0	2.7	441	100.0	2.7
81	81	Dexter	429	−2.2	45.7	Specialty chemicals	3	−91.4	8.0	0.8	299	44.2	1.1
82	82	Borden Chemicals	420	−0.1	100.0	Basic chemicals	93	8.4	100.0	22.0	507	100.0	18.2
83	76	Sun Co.	415	−14.6	3.5	Petroleum	na	na	na	na	na	na	na
84	84	Stepan	414	16.3	100.0	Specialty chemicals	21	−9.1	100.0	5.2	233	100.0	9.2
85	83	Vulcan Materials	359	−12.2	35.7	Nonmetallic minerals	43	−41.2	50.5	11.9	na	na	na
86	85	Crompton & Knowles	341	9.6	75.7	Specialty chemicals	51	19.0	72.0	15.1	252	84.2	20.4
87	—	Lonza	330	10.0	100.0	Specialty chemicals	na	na	na	na	na	na	na
88	86	First Mississippi[f]	327	10.8	60.9	Agrochemicals	36	58.2	128.1	11.1	173	38.3	21.1
89	90	Mississippi Chemical[f]	322	27.4	100.0	Farm cooperative	39	691.9	100.0	12.0	325	100.0	11.9
90	87	Calgon Carbon	308	8.2	100.0	Basic chemicals	61	−1.9	100.0	19.9	336	100.0	18.2
91	88	Petrolite[j]	305	7.7	94.1	Specialty chemicals	22	32.8	91.1	7.3	196	80.3	11.4
92	75	Nova	263	−46.3	100.0	Basic chemicals	na	na	na	na	na	na	na
93	91	Georgia-Pacific	223	−9.7	3.7	Wood products	na	na	na	na	na	na	na
94	93	Sequa Corp.	213	6.0	11.3	Diversified	37	23.8	31.2	17.2	127	6.0	28.9
95	92	Quaker Chemical	191	−5.2	100.0	Specialty chemicals	15	28.6	100.0	8.1	156	100.0	9.9
96	94	Sherex	168	−5.4	100.0	Specialty chemicals	na	na	na	na	na	na	na
97	95	Lawter International	153	1.9	100.0	Specialty chemicals	30	8.9	100.0	19.7	178	100.0	16.9
98	97	Cambrex Corp.	144	8.1	100.0	Specialty chemicals	0[k]	−93.1	100.0	0.2	112	100.0	0.3
99	96	LeaRonal[l]	142	1.3	100.0	Specialty chemicals	10	−27.0	100.0	7.2	92	100.0	11.1
100	100	Sybron	131	2.7	100.0	Specialty chemicals	na	na	na	na	na	na	na

a Operating profit is sales less administrative expenses and cost of sales. **b** Chemical operating profit as a percentage of sales. **c** Chemical operating profit as a percentage of identifiable chemical assets. **d** Chemical sales include significant amounts of nonchemical products. **e** Fiscal year ended Sept. 30. **f** Fiscal year ended June 30. **g** Fiscal year ended Aug. 31. **h** Fiscal year ended Nov. 30. **i** Does not include all chemical sales. **j** Fiscal year ended Oct. 31. **k** Because of rounding $300,000 does not show. **l** Fiscal year ended Feb. 28, 1991. **na** = not available.

CIRCLE 6 ON READER SERVICE CARD

2 FINANCES OF THE U.S. CHEMICAL INDUSTRY

FINANCIAL ANALYSIS: Most measures of chemical company performance declined in 1991

		Profit margin[a]	Return on investment[b]	Debt as % of debt plus equity	% total sales abroad[c]	% total assets abroad[d]	Sales per employee[e]	Dividends as % of net income	CAPITAL SPENDING[f] as % of sales	CAPITAL SPENDING[f] as % of net plant	R&D as % of sales	Sales as % of assets	Net plant as % of gross plant
SALES OVER $1.5 BILLION													
Air Products[g]	1991	8.5%	4.0%	33.9%	26.7%	31.8%	$201	33.7%	17.3%	19.3%	2.7%	69.3%	49.2%
	1990	7.9	3.9	36.1	24.5	35.5	207	33.4	16.2	18.8	2.5	74.2	49.6
American Cyanamid	1991	7.2	5.8	12.8	38.7	27.0	158	38.0	7.9	19.4	9.9	98.7	52.1
	1990	2.4	1.7	13.1	39.6	27.2	143	118.9	8.2	19.7	10.1	89.8	51.5
Arco Chemical	1991	5.6	3.7	39.8	43.8	36.9	645	158.9	16.0	20.1	2.4	74.0	73.0
	1990	9.4	6.8	40.2	44.4	36.6	702	91.6	19.4	30.5	2.1	74.3	71.7
Dow Chemical	1991	5.1	3.4	39.2	51.7	44.0	302	73.6	10.2	21.9	6.2	76.1	42.5
	1990	7.0	5.1	37.4	52.0	45.4	318	51.4	10.7	25.7	5.7	82.5	43.1
Ethyl	1991	8.3	10.3	39.9	19.3	5.5	429	33.2	6.5	21.7	2.7	32.6	51.2
	1990	8.9	12.0	39.5	21.2	4.9	441	112.1	6.0	22.4	2.6	37.6	50.8
Freeport-McMoRan	1991	6.1	2.3	83.3	29.6	na	na	179.9	50.9	35.7	na	44.3	67.0
	1990	1.7	0.7	82.4	27.3	na	na	564.0	39.0	27.9	na	57.0	63.5
B. F. Goodrich	1991	0.2	0.2	22.1	20.9	18.6	171	1337.5	8.5	18.0	3.1	108.9	56.8
	1990	2.5	2.3	13.2	24.7	18.6	165	100.6	10.0	21.9	3.0	102.8	60.3
W. R. Grace	1991	3.6	3.1	47.0	41.1	31.8	130	55.9	7.4	17.5	2.5	100.7	51.1
	1990	3.0	2.8	50.7	36.9	34.1	138	59.5	7.6	20.9	2.2	108.5	50.2
Hercules	1991	4.7	3.0	20.1	30.0	21.5	169	76.4	7.3	14.5	2.9	84.5	45.5
	1990	3.0	2.4	23.6	27.8	18.6	161	109.4	8.5	18.8	2.9	86.5	47.3
Imcera Group[h]	1991	5.9	4.7	23.2	34.3	25.3	164	24.4	7.6	19.6	4.9	72.6	66.7
	1990	4.1	3.7	47.8	34.4	27.3	148	43.8	6.0	14.6	5.3	66.9	69.2
Monsanto	1991	7.0	5.5	33.9	36.4	34.2	226	41.5	6.7	17.6	8.0	96.1	42.5
	1990	6.1	4.9	28.8	36.8	32.4	219	44.3	8.3	21.5	7.7	97.4	45.8
Morton International[h]	1991	7.3	7.0	18.8	29.4	23.9	187	32.7	8.6	22.6	3.1	99.0	58.8
	1990	8.2	7.4	20.6	30.4	25.6	169	30.7	6.8	17.2	2.9	90.4	59.7
Olin	1991	3.0	2.1	43.8	7.6	10.0	158	72.4	7.8	19.7	1.8	113.1	37.0
	1990	3.2	2.8	39.5	7.8	10.9	171	58.3	7.2	22.6	2.5	138.9	36.1
PPG Industries	1991	4.5	3.0	29.8	36.1	34.0	168	71.6	5.8	10.4	3.9	93.7	51.2
	1990	7.9	5.8	31.1	34.3	33.5	172	37.0	6.9	12.8	3.6	98.6	54.3
Quantum	1991	def	def	108.8	na	na	na	0	6.3	8.1	1.9	79.2	67.3
	1990	0.8	0.6	104.2	na	na	na	0	17.3	22.7	1.8	82.4	69.5
Rohm & Haas	1991	5.9	3.9	36.8	50.1	32.8	215	49.1	9.6	18.0	6.6	95.4	48.8
	1990	7.3	5.5	32.7	43.7	32.4	219	38.2	14.6	29.6	6.3	104.5	50.2
Union Carbide	1991[i]	0.9	0.5	34.1	27.6	17.1	292	352.3	8.2	16.0	3.2	71.4	45.1
	1990	4.6	3.0	49.6	36.2	32.3	204	39.1	9.8	17.2	2.5	87.3	48.5
Witco	1991	4.5	4.7	22.3	21.1	20.9	236	52.6	4.6	15.7	1.7	136.1	47.9
	1990	4.2	4.4	28.2	19.8	20.2	225	56.4	5.6	19.3	1.6	138.4	48.8
AVERAGE 1991		**4.9%**	**3.4%**	**38.9%**	**37.2%**	**30.4%**	**$214**	**67.3%**	**9.6%**	**18.9%**	**4.9%**	**80.0%**	**49.3%**
AVERAGE 1990		**5.5**	**4.1**	**39.7**	**37.2**	**32.2**	**210**	**57.9**	**10.4**	**21.8**	**4.5**	**85.5**	**50.2**

		Profit margin[a]	Return on investment[b]	Debt as % of debt plus equity	% total sales abroad[c]	% total assets abroad[d]	Sales per employee[e]	Dividends as % of net income	CAPITAL SPENDING[f] as % of sales	CAPITAL SPENDING[f] as % of net plant	R&D as % of sales	Sales as % of assets	Net plant as % of gross plant
SALES LESS THAN $1.5 BILLION													
Betz Laboratories	1991	11.3%	11.6%	27.6%	19.8%	22.5%	$167	54.4%	8.8%	22.9%	4.0%	139.9%	56.4%
	1990	11.0	11.3	31.0	19.0	22.0	162	56.2	9.6	24.6	3.9	139.7	57.9
Cabot[g]	1991	2.7	2.4	46.4	45.8	42.6	280	66.0	13.4	29.5	2.5	101.3	59.0
	1990	4.2	3.4	45.7	41.8	36.0	279	41.8	10.4	19.9	2.1	96.6	57.3
Calgon Carbon	1991	18.3	10.0	10.7	56.2	35.2	138	17.1	33.9	35.0	2.8	62.0	77.9
	1990	13.9	12.4	5.3	39.2	43.5	190	15.4	16.7	33.0	2.0	99.9	76.4
Crompton & Knowles	1991	8.0	13.1	35.1	15.8	18.8	252	32.8	2.5	14.3	2.1	145.9	90.1
	1990	7.7	10.4	37.4	18.7	19.2	192	31.2	4.2	21.3	2.2	138.0	62.1
First Mississippi[h]	1991	1.0	0.9	38.8	27.3	na	na	110.0	8.8	16.0	na	112.6	63.7
	1990	0.9	0.5	39.7	24.0	na	na	135.0	13.0	20.8	na	97.2	45.0
H. B. Fuller[i]	1991	3.2	4.5	24.7	47.7	54.2	152	20.2	3.5	14.4	2.0	168.9	59.0
	1990	2.7	3.7	30.9	46.3	54.2	142	25.7	4.0	15.6	2.0	161.9	61.3
Georgia Gulf	1991	7.3	11.9	255.1	na	na	760	0	3.4	12.8	na	201.7	64.8
	1990	10.2	17.9	263.9	na	na	868	0	6.2	27.1	na	204.1	68.0
Great Lakes Chemical	1991	12.0	11.8	13.4	45.5	37.7	na	12.1	5.4	17.6	3.0	79.3	58.5
	1990	13.2	11.5	9.2	53.1	42.7	na	11.5	4.6	13.3	2.7	75.8	59.5
International Flavors	1991	16.3	11.4	0	68.9	45.6	241	54.4	5.2	18.4	6.1	83.5	51.4
	1990	16.3	11.4	0	70.1	46.6	230	52.5	4.3	15.5	6.0	85.3	51.7
Lawter International	1991	17.3	13.3	4.3	43.3	30.0	307	56.5	5.8	26.0	2.5	85.8	46.3
	1990	15.6	13.4	4.7	43.7	32.1	321	53.7	4.1	21.7	2.5	97.7	43.2
Loctite	1991	13.6	14.7	6.6	60.1	66.4	156	31.5	6.0	27.8	4.0	106.1	56.0
	1990	12.1	13.0	9.8	55.0	65.5	151	31.2	5.1	27.4	3.9	113.5	55.6
Lubrizol	1991	8.4	7.4	4.2	53.7	4[illegible]	277	43.1	5.6	21.7	5.4	125.3	39.5
	1990	13.2	12.2	6.8	56.8	43.7	280	27.5	5.4	21.9	5.2	129.6	39.9
Nalco Chemical	1991	10.9	9.1	42.7	38.6	34.2	181	50.4	11.1	27.7	3.8	93.4	51.5
	1990	10.8	10.5	38.3	28.2	20.4	207	48.2	9.5	27.4	3.7	116.9	49.9
Petrolite[k]	1991	4.6	3.9	0	32.4	28.5	na	86.1	6.5	19.5	3.5	132.6	41.2
	1990	4.4	3.4	2.3	31.3	37.5	na	96.7	5.8	14.8	4.1	118.9	44.5
Quaker	1991	5.6	6.3	5.0	39.8	35.1	186	44.2	4.4	17.3	na	112.8	54.7
	1990	7.0	8.4	5.2	41.1	35.0	187	30.5	6.3	27.3	na	132.2	55.3
Sigma-Aldrich	1991	13.5	11.4	13.6	28.5	29.3	140	14.2	4.4	13.6	na	98.8	61.5
	1990	13.5	11.3	16.1	28.1	29.0	129	14.3	6.1	16.9	na	96.9	66.2
Stepan	1991	3.0	2.9	49.7	14.2	14.2	314	28.7	8.1	21.5	3.7	152.5	48.7
	1990	3.7	3.8	48.3	11.7	13.6	297	22.0	9.8	26.8	3.4	157.7	49.6
Sterling Chemical[g]	1991	6.8	8.6	38.8	45.2	na	571	97.2	6.3	14.9	na	150.3	74.9
	1990	11.7	14.8	37.1	35.4	na	na	93.6	3.9	9.2	na	143.8	78.8
AVERAGE 1991		**8.8%**	**8.4%**	**27.8%**	**43.1%**	**37.5%**	**$226**	**38.8%**	**7.4%**	**21.7%**	**3.7%**	**109.9%**	**55.9%**
AVERAGE 1990		**9.7**	**9.1**	**30.2**	**41.6**	**36.6**	**216**	**35.3**	**7.1**	**20.6**	**3.5**	**112.8**	**54.6**

Note: Net income is from continuing operations, excluding extraordinary and nonrecurring items where possible. **a** Net income as a percentage of sales. **b** Net income as a percentage of current assets plus gross plant. **c** Consolidated sales only. **d** Foreign identifiable assets as a percentage of total assets. **e** Thousands of dollars. **f** Actual spending on construction of new facilities and purchase of land and new equipment in consolidated businesses. **g** Fiscal year ended Sept. 30. **h** Fiscal year ended June 30. **i** Excludes industrial gases business. **j** Fiscal year ended Nov. 30. **k** Fiscal year ended Oct. 31. **na** = not available. **def** = deficit.

Chemical capital spending nose-dives

Chemical capital spending plummeted in 1991. Big budget projects felt the impact of the recession as the 25 major chemical firms that C&EN tracks annually skimmed the fat off their spending programs, with an average drop of 16% to a combined total of $9.0 billion. The 1991 drop was the largest since 1983, when industry overcapacity and recession forced these same companies to cut capital outlays 25% to hit the decade low of $5.0 billion for the group.

The 1991 spending decline follows three years of big increases, when sales and profits were generally healthier for the group than they were in 1991. From 1987 to 1990, chemical capital spending for these companies grew at an average rate of 21%, well above the 4% compound annual growth the group has made on plant outlays since 1981. Though most chemical companies began to experience the effects of the recession in late 1989, they were committed to building projects that kept capital outlays growing at 11% in 1990 to reach a 10-year high of nearly $11 billion.

Capital spending as a percentage of sales for these 25 companies also fell in 1991, to 9.4%. In each of the previous two years, spending as a percentage of sales set new highs for the decade: 10.9% in 1990 and 10.2% in 1989. The reason this percentage rose so fast is that although sales leveled off, chemical companies were still committed to spending projects they had planned in rosier times.

C&EN's sample of chemical firms includes one new company this year and excludes one previously listed. No longer in the group is Chemed, which early last year sold its principal chemical operations, DuBois Chemicals, to Diversey Corp., a subsidiary of Canadian brewer Molson. The newcomer to the list is H. B. Fuller, the St. Paul, Minn., manufacturer of specialty chemicals, and the table and accompanying graphs are all revised to reflect the change.

The Department of Commerce's much wider survey of the chemical industry draws a different picture of capital spending trends. This survey registers a 4% increase in capital expenditures in 1991 to $21.5 billion, and projects close to a 9% increase in capital outlays for the industry in 1992.

The C&EN data are restricted to companies that Commerce might characterize as producers of industrial chemicals and synthetic materials. These producers make up less than half of the companies Commerce considers chemical. Also included in the Commerce Department survey are manufacturers of chemical products such as pharmaceuticals, soaps, toiletries, and paints. Capital spending by all manufacturing companies declined almost 5% in 1991 to $184 billion, according to Commerce.

A separate Commerce survey shows that capital outlays abroad declined in 1991 for chemical companies and for all manufacturers for the first time since 1983. For chemical firms, those outlays dropped more than 4% in 1991, following a jump of nearly 24% in 1990. The survey predicts modest recovery in 1992, with expenditures by chemical companies abroad expected to reach $6.6 billion, almost 2% above 1991.

INDUSTRY CAPITAL SPENDING: Chemicals, petroleum outperform manufacturing generally

$ Billions	1992[a]	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982
Chemicals	$ 23.30	$ 21.45	$ 20.63	$ 18.47	$ 19.25	$ 16.42	$ 16.81	$ 16.44	$ 15.32	$ 12.96	$ 12.66
Iron and steel	6.42	6.64	7.78	7.87	6.16	4.69	3.32	4.12	3.54	3.25	3.78
Nonferrous metals	2.32	2.81	2.88	2.64	2.77	2.16	1.93	1.88	2.13	1.74	1.90
Paper	10.76	11.63	16.53	15.58	11.23	9.01	8.77	8.59	7.21	5.92	5.60
Petroleum	31.73	35.98	34.79	30.08	19.93	17.12	17.92	26.71	25.53	23.14	26.39
Rubber	3.65	3.44	3.48	3.79	3.86	3.52	3.89	3.86	3.11	2.46	2.16
Stone, clay, glass	3.09	2.89	3.29	4.00	3.59	3.37	3.14	3.40	3.09	2.77	2.90
All manufacturing	182.81	183.61	192.61	183.80	165.70	145.90	142.69	153.48	138.82	116.20	120.68

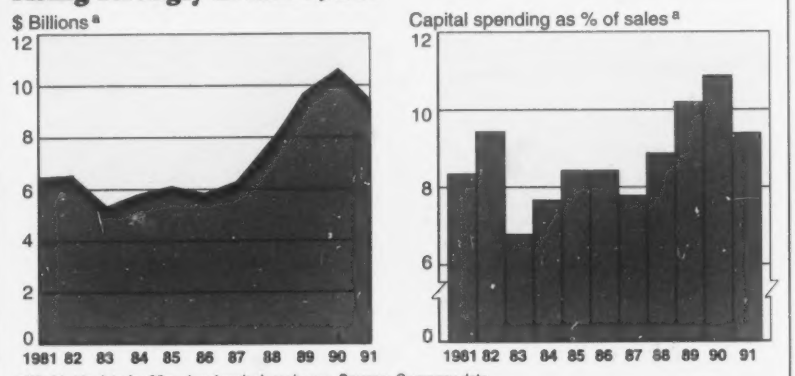
a Estimate. **Source:** Department of Commerce

Capital spending by chemical firms abroad holds on to last year's gain

$ Billions[a]	1992[b]	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982
Chemicals and allied products	$ 6.6	$ 6.5	$ 6.8	$ 5.5	$ 4.7	$ 3.7	$ 3.1	$ 2.7	$ 2.4	$ 2.3	$ 2.8
Metals, primary and fabricated	1.3	1.3	1.8	1.4	1.1	0.8	0.9	0.9	1.0	0.9	0.9
Petroleum	20.8	20.8	16.7	13.2	13.3	9.8	9.6	13.7	14.1	15.9	19.7
All manufacturing	29.6	28.2	29.4	25.3	20.4	17.2	16.4	14.9	13.6	13.6	16.8

a By majority-owned affiliates of U.S. companies. b Planned. **Source:** Department of Commerce

Chemical capital spending peaked in 1990 after rising strongly in late 1980s



a Worldwide data for 25 major chemical producers. **Source:** Company data

CHEMICAL CAPITAL SPENDING: Falls sharply for major companies in 1991

$ Millions	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
Air Products	$ 506	$ 468	$ 414	$ 409	$ 323	$ 367	$ 392	$ 263	$ 246	$ 347	$ 323
American Cyanamid	392	376	398	374	268	263	203	200	165	171	181
Cabot[a]	213	298	233	214	83	80	184	505	80	152	194
Crompton & Knowles	11	16	13	7	4	4	3	3	2	3	7
Dow Chemical	1908	2,119	1756	1264	995	890	806	781	630	829	1176
Du Pont[b]	2045	2,045	2608	2106	1735	1357	1229	1176	989	888	1212
Ethyl	180	166	119	151	139	134	90	103	85	92	141
H. B. Fuller	30	31	41	40	30	13	15	13	15	17	10
B. F. Goodrich	219	243	240	181	143	144	202	153	115	144	205
W. R. Grace	447	514	485	418	243	199	348	380	353	560	657
Great Lakes Chemical	71	49	40	47	35	18	21	29	20	29	47
Hercules	214	273	293	251	205	257	234	218	168	174	167
Loctite	34	29	24	15	17	11	9	10	9	9	11
Lubrizol	82	77	65	55	42	41	40	30	25	52	75
Monsanto	591	750	607	590	505	520	645	614	560	673	668
Nalco Chemical	137	115	86	62	57	64	60	53	41	56	59
Olin	177	187	142	147	115	128	154	165	123	129	186
PPG Industries	335	567	671	410	499	498	452	315	450	452	376
Petrolite	22	18	19	20	19	25	24	11	9	24	15
Quaker Chemical	8	13	8	5	4	5	6	4	2	2	1
Quantum Chemical	161	459	589	334	154	102	76	116	71	66	44
Rohm & Haas	265	412	385	338	222	179	159	124	72	126	182
Stepan	34	38	34	20	26	14	19	12	10	16	12
Union Carbide	817	744	785	671	502	524	649	670	761	1179	1186
Witco	74	91	70	72	69	60	76	85	55	54	83
TOTAL	**$8973**	**$10,661**	**$9623**	**$7830**	**$6056**	**$5769**	**$6043**	**$5846**	**$4955**	**$6568**	**$6254**
ANNUAL CHANGE	**−16%**	**11%**	**23%**	**29%**	**5%**	**−5%**	**3%**	**18%**	**−25%**	**5%**	**−11%**

Note: Figures are for worldwide spending on construction, equipment, and land in consolidated businesses. Where possible, acquisition costs and investments in nonconsolidated businesses are excluded. Prior years are not restated to reflect company revisions. **a** Includes acquisitions and investments. **b** Excludes Conoco. **Source:** Company data

2 FINANCES OF THE U.S. CHEMICAL INDUSTRY

SHIPMENTS: Only drugs, soaps, toiletries had strong growth in 1991

$ Billions	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	% annual change 1990–91	% annual change 1981–91
All manufacturing industries	$2863.6	$2917.4	$2781.4	$2611.6	$2390.0	$2260.3	$2279.1	$2254.4	$2054.9	$1960.2	$2017.5	−2%	4%
Chemicals and allied products	288.0	285.6	255.5	240.5	212.7	197.1	197.3	198.2	183.2	170.7	180.5	1	5
Industrial chemicals	151.7	156.3	150.6	145.5	126.2	112.2	114.7	119.4	109.1	100.1	112.8	−3	3
Drugs, soaps, and toiletries	104.7	97.6	82.0	73.1	67.1	65.8	60.9	57.5	54.4	50.7	46.9	7	9
Petroleum and coal products	167.3	179.4	138.5	124.2	124.5	124.9	179.1	189.0	192.6	208.9	224.1	−7	-3
Rubber and plastic products	92.6	91.7	95.8	91.1	80.5	73.4	71.3	69.5	60.3	55.4	53.2	1	6
Paper and allied products	122.2	128.8	130.4	124.2	110.3	97.9	93.4	94.8	84.6	79.9	80.2	−5	4

Source: Department of Commerce

PRICES: Down for industrial chemicals as well as plastic resins

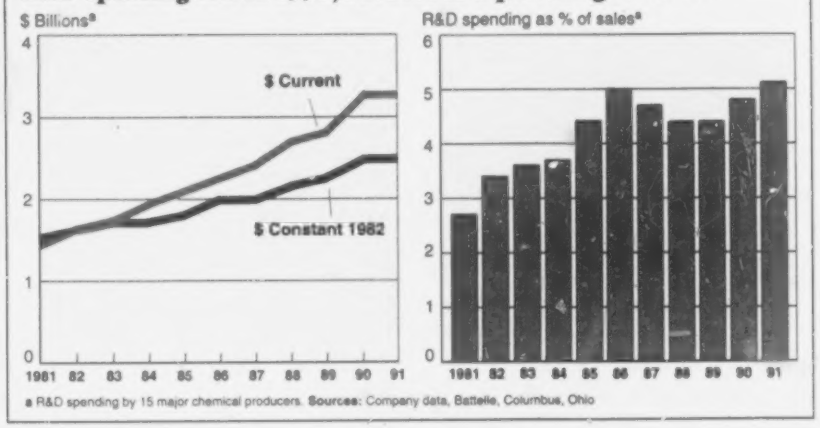
Producer price indexes, 1982 = 100	Annual average 1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	% annual change 1990–91	% annual change 1981–91
All commodities	116.5	116.3	112.2	106.9	102.8	100.2	103.1	103.7	101.3	100.0	98.0	0%	2%
Industrial commodities	116.5	115.8	111.6	106.3	102.6	99.9	103.7	103.3	101.1	100.0	97.4	1	2
Finished goods	121.7	119.2	113.6	108.0	105.4	103.2	104.7	103.7	101.6	100.0	96.1	2	3
Chemicals and allied products	125.6	123.6	123.0	116.3	106.4	102.5	103.7	102.9	100.2	100.0	98.4	2	3
Industrial chemicals	111.8	113.2	114.8	106.8	95.5	91.5	96.7	96.8	97.3	100.0	103.0	−1	1
Prepared paint	129.9	124.8	119.5	112.2	108.1	107.0	105.3	103.7	100.7	100.0	95.0	4	3
Paint materials	135.8	136.3	129.1	115.7	107.3	104.4	109.5	108.2	100.3	100.0	98.5	0	3
Drugs and pharmaceuticals	182.6	170.8	160.0	148.4	139.1	129.9	122.2	114.2	107.7	100.0	92.1	7	7
Fats and oils, inedible	86.8	88.1	95.5	110.9	92.7	80.5	110.6	139.1	106.2	100.0	110.7	−1	−2
Agricultural chemicals and chemical products	111.7	107.4	108.7	104.5	96.4	94.2	96.2	97.4	96.0	100.0	97.5	−4	1
Plastic resins and materials	120.0	124.1	133.4	132.4	110.3	104.4	107.5	108.9	102.4	100.0	102.0	−3	2
Other chemicals and allied products	121.5	118.9	117.3	111.9	107.0	105.8	105.2	102.7	101.3	100.0	94.1	2	3
Rubber and plastic products	115.1	113.6	112.6	109.3	103.0	101.9	101.9	102.2	100.8	100.0	96.4	1	2

Source: Department of Labor

Chemical stock prices have been moving upward for past 18 months

a C&EN stock price index of American Cyanamid, Dow Chemical, W. R. Grace, Hercules, Monsanto, Rohm & Haas, and Union Carbide, weighted according to number of shares outstanding for each company.

R&D spending flat in 1991, but rose as a percentage of sales



a R&D spending by 15 major chemical producers. **Sources:** Company data, Battelle, Columbus, Ohio

R&D SPENDING: Most chemical companies reined in expenditures in 1991

$ Millions	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
CHEMICAL COMPANIES											
Air Products[a]	$ 80	$ 72	$ 71	$ 72	$ 57	$ 61	$ 51	$ 44	$ 40	$ 37	$ 32
American Cyanamid	492	460	406	365	314	278	251	232	208	185	166
Dow Chemical	1,159	1,136	873	772	670	605	547	507	492	460	404
Ethyl	69[b]	65[b]	61[b]	59[b]	50	47	47	40	39	39	37
W. R. Grace	150	148	125	119	107	94	92	81	73	64	57
Hercules	86	92	79	74	74	71	76	72	74	74	65
International Flavors	62	57	52	50	45	39	34	32	32	31	30
Lubrizol	80	74	70	65	62	51	44	33	37	36	33
Monsanto	627	612	598	648	615	596	470	370	290	264	233
Morton International[c,d,e]	59	48	38	35	31	29	25	30	23	7	6
Nalco	47	45	41	37	35	33	32	32	30	33	30
Olin	41	66	66	58	62	56	53	52	49	45	38
Petrolite	11	12	12	12	12	12	12	12	13	10	8
Rohm & Haas	183	178	175	156	142	133	124	109	100	92	77
Union Carbide	190	191	181	159	159	148	275	265	245	240	207
TOTAL	**$ 3,336**	**$ 3,256**	**$ 2,848**	**$ 2,681**	**$ 2,435**	**$ 2,253**	**$ 2,133**	**$ 1,911**	**$1745**	**$1617**	**$1423**
ANNUAL CHANGE	**2%**	**14%**	**6%**	**10%**	**8%**	**6%**	**12%**	**10%**	**8%**	**14%**	**19%**
PHARMACEUTICAL & DIVERSIFIED COMPANIES											
Allied-Signal[c]	$ 381	$ 426	$ 381	$ 415	$ 400	$ 459	$ 343	$ 295	$ 280	$ 186	$ 152
AT&T Bell Labs	3,100	2,900	2,800	2,660	2,250	2,100	1,900	1,900	2000	2020	1590
Bristol-Myers Squibb	993	881	789	688	563	474	412	344	301	260	226
Du Pont	1,298	1,428	1,387	1,319	1,223	1,156	1,144	1,097	966	879	718
Eastman Kodak	1,494	1,329	1,253	1,147	992	1,059	976	838	746	710	615
Eli Lilly	767	703	605	512	466	427	370	341	294	267	235
FMC	135	158	150	144	132	146	149	121	102	105	94
IBM	5,001	4,419	5,201	4,419	3,998	3,975	3,457	3,148	2500	2050	1610
Merck & Co.	998	854	751	669	566	480	426	393	356	320	274
3M	914	865	784	721	650	586	520	454	396	349	306
Pfizer	757	640	531	473	401	336	287	255	230	199	179
PPG Industries	220	218	233	232	227	204	176	150	127	127	119
Procter & Gamble[d]	786	693	628	615	549	479	400	369	327	286	253
Schering-Plough	426	380	327	298	251	212	175	164	145	127	109
Upjohn	491	427	407	380	356	314	284	247	218	185	162
TOTAL	**$17,751**	**$16,321**	**$16,227**	**$14,692**	**$13,024**	**$12,407**	**$11,019**	**$10,116**	**$8988**	**$8070**	**$6642**
ANNUAL CHANGE	**9%**	**1%**	**10%**	**13%**	**5%**	**13%**	**9%**	**13%**	**11%**	**21%**	**17%**

Note: Prior years are not restated to reflect company revisions. **a** For fiscal year ending Sept. 30. **b** Adjusted to reflect spin-off of Tredegar Industries. **c** Includes all company-financed R&D but excludes contract R&D. **d** Fiscal year ends June 30. **e** Data for Morton Thiokol prior to 1985. **Source:** Company data

Explanation of company results table headings

Year. Data are for calendar year unless otherwise indicated.

Net sales. Gross sales, less discounts, allowances, and returns; generally excludes excise taxes and other operating income or revenues.

Net income. Net sales and other income, less operating costs, nonoperating charges, depreciation, depletion, interest expense, deferred charges, minority interest in income, and taxes. Nonrecurring or extraordinary credits and charges have been excluded in most cases, and are indicated by a footnote.

Total assets. Sum at year's end of current assets, investments, prepaid expenses, net plant and equipment, and other tangible assets. Excludes insofar as possible intangible assets including goodwill, value of patents, and the like.

Net plant and equipment. Value at year's end of fixed assets, less accumulated depreciation, amortization, and depletion.

Capital expenditures. Total spending during the year for new fixed assets, such as plant, equipment, and land, and for replacement and modernization of facilities.

Stockholders' equity. Equity at year's end of preferred and common stockholders, including value of capital stock, capital and earned surplus, and surplus reserves, as well as contingency and miscellaneous reserves for which no definite purpose is stated. Intangible assets are deducted insofar as possible.

Net income (breakdown). Percent of sales: net income divided by net sales. Percent of stockholders' equity: net income divided by stockholders' equity. Dollars per share: net income, less preferred dividends, divided by the number of shares of common stock outstanding. All figures are adjusted for stock splits, but no adjustment has been made for earlier years as a result of stock dividends or for dilution that might result from the conversion of preferred stock or debt to common stock or the exercise of stock options outstanding.

Dividends per share. Cash dividends paid (or declared) on each share of common stock; excludes the value of stock dividends, which are indicated by a footnote.

Dividend yield. Dividends per share divided by the average of the high and low prices of the common stock during the calendar year.

Stock price range. High-low market prices of common stock during the year, adjusted for stock splits but not for stock dividends.

Price-earnings ratio. Average of the high and low prices of the common stock during the calendar year divided by net income per share.

COMPANY RESULTS: Earnings fall for largest chemical firms, others generally profitable

Year	Net sales	Net income	Total assets	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME % of sales	NET INCOME % of stockholders' equity	NET INCOME $ per share	Dividend, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
					(Money figures in millions of dollars unless otherwise indicated)								
CHEMICALS													
Air Products													
1991[a]	$2931	$248.9	$4163	$2622.6	$506.4	$1,777	8.5%	14.0%	$2.22	$0.75	2.4%	$37–25⅝	14.1
1990[a]	2895	229.9	3845	2485.1	467.5	1,634	7.9	14.1	2.07	0.69	2.7	30½–21½	12.5
1989[a]	2642	222.1	3313	2217.6	413.7	1,393	8.4	16.0	2.02	0.63	2.9	24⅜–18⅞	10.7
1988[a]	2432	213.7	2962	2061.6	386.9	1,235	8.8	17.3	1.95	0.55	2.7	26⅝–14½	10.6
American Cyanamid													
1991	$4986	$358.8	$4838	$2018.9	$392.1	$2,387	7.2%	15.0%	$3.85	$1.46	2.5%	$69–48½	15.3
1990	4570	107.8[b]	4864	1906.0	375.5	2,335	2.4	4.6	1.15[b]	1.35	2.2	61½–42	5.3
1989	4825	292.0	4720	1757.0	397.6	2,070	6.1	14.1	3.12	1.31	2.5	60⅜–45⅝	17.0
1988	4592	305.6	4332	1556.8	373.8	1,801	6.7	17.0	3.41	1.16	2.4	56–41⅞	14.4
Arco Chemical													
1991	$2837	$188.0	$3676	$2166.0	$435.0	$1,696	6.6%	11.1%	$1.96	$2.50	6.4%	$44¼–33⅛	19.7
1990	2830	308.0[c]	3739	1768.0	539.0	1,758	10.9	17.5	3.21[c]	2.50	6.8	44¼–29¾	11.5
1989	2663	405.0	2655	1263.0	262.0	1,591	15.5	25.5	4.22	2.125	6.1	40⅜–28¾	8.2
1988	2700	494.0	2548	1078.0	214.0	1,375	18.3	35.9	5.00	0.85	2.8	38–23¼	6.1
Betz Laboratories													
1991	$666	$75.5	$471	$254.6	$58.4	$254	11.3%	29.8%	$2.47	$1.16	2.3%	$62–38¾	20.4
1990	597	65.5	421	233.5	57.5	214	11.0	30.6	2.12	1.01	2.7	43¼–30¾	17.5
1989	517	55.9	359	201.5	53.0	173	10.8	32.3	1.76	0.89	3.2	31⅛–23⅝	15.5
1988	448	48.4	308	175.0	43.5	220	10.8	22.0	3.15	1.60	3.4	52½–41¼	14.9

a Fiscal year ends Sept. 30. b From continuing operations; excludes net income from discontinued operations of $245 million ($2.56 per share) but includes special net costs of $206.2 million ($2.15 per share) to curtail and consolidate product lines, reduce the carrying value of certain assets, increase environmental remediation costs, and reduce employees. c Excludes net gain from cumulative effect of change in accounting principal of $43 million ($0.45 per share).

Year	Net sales	Net income	Total assets	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME % of sales	NET INCOME % of stockholders' equity	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
					(Money figures in millions of dollars unless otherwise indicated)								
Borden Chemicals & Plastics													
1991	$410	$51.6	$507	$369.2	$18.0	$293	15.7%	17.6%	$1.39[a]	$1.98[a]	17.1%	$14¾–8⅜	8.3
1990	421	45.3	544	395.8	22.1	315	10.8	14.4	1.22[a]	1.95[a]	19.0	12¾–7¾[a]	8.4
1989	466	69.5	550	417.2	28.2	342	14.9	20.3	1.87[a]	2.45[a]	14.4	24–10[a]	9.1
1988	553	121.0	605	429.3	18.9	363	21.9	33.3	3.26[a]	3.02[a]	19.5	20⅛–10⅞[a]	4.8
Cabot													
1991[b]	$1,482	$39.8[c]	$1,365	$670.4	$198.0	$329	2.7%	12.1%	$1.69	$1.04	3.3%	$35⅞–26⅝	18.5
1990[b]	1,673	71.0	1,627	878.7	174.4	466	4.2	15.2	2.73	1.04	3.3	37½–25	11.4
1989[b]	1,937	(6.5)[d,e]	1,401	743.2	192.3	472	—	—	(0.40)[d,e]	1.01	2.5	45–34⅞	—
1988[b]	1,677	61.2[f]	1,530	838.9	170.0	594	3.6	10.3	2.27[f]	0.92	2.5	48⅜–25½	16.3
Crompton & Knowles													
1991	$450	$35.9	$276	$80.2	$11.4	$108.0	8.0%	33.2%	$0.73	$0.25	1.6%	$20¼–8⅜	21.8
1990	390	30.0	252	76.7	16.4	87.0	7.7	34.5	0.61	0.195	2.1	11½–6⅝	15.0
1989	356	24.5	190	50.8	13.4	71.4	6.9	34.3	0.50	0.145	2.5	7⅞–3¾	11.6
1988	290	16.8[g]	177	43.7	7.0	53.5	5.8	31.5	0.71[g]	0.105	3.1	4½–2½	9.8
Dexter													
1991	$938	$(7.1)[d]	$721	$299.3	$61.7	$250	—	—	$(0.29)[d]	$0.88	3.9%	$26⅛–18½	—
1990	908	42.1	697	274.1	43.9	278	4.6%	15.1%	1.74	0.88	4.1	24½–18	12.2
1989	849	43.0	611	252.9	33.1	242	5.1	17.8	1.73	0.82	3.0	34¼–20⅛	15.9
1988	827	39.9[h]	541	186.9	26.1	222	4.8	18.0	1.61[h]	0.80	3.3	28¾–20¼	15.2
Dow Chemical													
1991	$18,807	$942.0	$20,418	$8,775.0	$1,908.0	$5,132	5.0%	18.4%	$3.46	$2.60	5.1%	$58–44⅛	14.8
1990	19,773	1,384.0	19,764	8,249.0	2,119.0	4,539	7.0	30.5	5.10	2.60	4.6	75¾–37	11.1
1989	17,600	2,487.0	18,169	7,642.0	1,764.0	3,960	14.1	62.8	9.20	2.18	3.4	72¼–55½	6.9
1988	16,682	2,410.0[i]	15,548	6,576.0	1,267.0	6,564	14.4	36.7	8.55[i]	1.63	2.9	62⅝–51⅛	6.7
Du Pont													
1991	$38,695	$1,403.0	$35,596	$20,610.0	$5,065.0	$16,218	3.6%	8.7%	$2.08	$1.68	4.1%	$50–32¾	19.9
1990	40,047	2,310.0	37,332	21,102.0	5,383.0	15,622	5.8	14.8	3.40	1.62	4.3	42⅜–31⅜	10.8
1989	35,534	2,480.0	33,829	18,876.0	4,285.0	14,912	7.0	16.6	3.53	1.45	4.1	42⅛–28⅝	10.0
1988	32,917	2,190.0	30,159	17,221.0	4,001.0	15,020	6.7	14.6	3.04	1.23	4.4	30⅞–25¼	9.3
Ethyl													
1991	$2,575[j]	$206.7	$7,785	$766.7	$166.1	$1,100	8.0%	18.8%	$1.75	$0.60	2.2%	$33–22¼	15.8
1990	2,514[j]	232.2	6,589	677.0	151.8	947	9.2	24.5	1.95	0.60	2.2	33–20½	13.7
1989	2,432[j]	219.0[k]	5,507	579.8	119.1	777	9.0	28.3	1.83[k]	0.51	2.0	29–21⅛	13.7
1988	2,718[l]	231.0	5,108	719.6	151.1	986	8.4	23.4	1.91	0.45	2.2	24⅛–17¼	10.8
Ferro													
1991	$1,057	$36.5[l]	$668	$234.7	$39.0	$301	3.5%	12.1%	$1.74[l]	$0.64	2.4%	$38½–15¼	15.4
1990	1,125	19.4	672	255.9	59.7	292	1.7	6.6	0.83	0.64	2.7	29⅜–17¼	28.1
1989	1,084	49.7	655	220.0	49.6	283	4.6	17.6	2.30	0.60	1.9	41⅜–22⅜	13.8
1988	1,009	46.6	575	197.2	49.3	282	4.6	16.5	2.26	0.46	2.3	27⅛–14	9.1
First Mississippi													
1991[m]	$537	$5.3	$457	$294.6	$47.2	$168	1.0%	3.2%	$0.27	$0.30	3.0%	$12⅜–7¾	37.3
1990[m]	498	4.4	497	310.0	64.6	175	0.9	2.5	0.22	0.30	1.9	19¼–11⅝	70.2
1989[m]	433	16.5	472	280.0	107.0	187	3.8	8.8	0.81	0.285	1.6	20½–14½	21.6
1988[m]	318	32.5	325	167.0	60.4	181	10.2	17.9	1.61	0.24	1.7	19⅛–9½	8.9
Freeport-McMoRan													
1991	$1,579	$41.0[n]	$3,565	$2,253.8	$804.2	$388	2.6%	10.6%	$0.57[n]	$2.50	6.7%	$31¾–43⅛	65.7
1990	1,581	283.5	3,101	2,204.5	615.7	337	17.9	84.1	4.70	2.50	7.4	30–38	7.2
1989	1,958	118.3	3,071	2,290.8	416.6	138	6.0	85.7	1.65	2.50	7.7	27⅛–38	19.7
1988	1,945	258.5	3,297	2,495.3	na	868	13.3	29.8	3.39	2.73	10.2	23⅝–29¾	7.9
Georgia Gulf													
1991	$838	$61.5	$416	$220.6	$28.3	$(358)[o]	7.3%	—	$1.75	0	—	$24¾–8⅞	9.6
1990	932	95.3	457	214.7	58.1	(424)[o]	10.2	—	3.07	0	—	11–4⅞[p]	2.6
1989	1,104	192.0	456	209.1	54.2	306	17.4	62.8%	7.58	1.00	2.1%	59⅞–36	6.3
1988	1,061	193.6	437	169.3	25.1	236	18.3	82.1	6.75	0.65	2.0	39⅞–24⅜	4.8

a Per partnership preference unit. **b** Fiscal year ends Sept. 30. **c** From continuing operations; excludes net income from discontinued operations of $9.5 million ($0.45 per share) and net gain on disposition of discontinued operations of $77.9 million ($3.66 per share). **d** Net loss. **e** From continuing operations; includes pretax loss on restructuring of energy group of $71.7 million but excludes net gain from sale of discontinued operations of $24.6 million ($0.95 per share). **f** Excludes extraordinary net charge on early retirement of debt of $0.8 million ($0.03 per share). **g** From continuing operations; excludes net loss from operation and disposal of maintenance chemicals business of $1.5 million ($0.06 per share). **h** From continuing operations; excludes net loss from discontinued operations of $4.4 million ($0.18 per share). **i** Excludes net loss on early extinguishment of debt of $12 million ($0.04 per share). **j** Includes insurance business revenues. **k** From continuing operations; excludes income from spun-off aluminum, plastics, and energy businesses of $11.9 million ($0.10 per share). **l** Excludes restructuring charge, after taxes, of $31.7 million ($1.66 per share). **m** Fiscal year ends June 30. **n** Excludes net changes in accounting for retirement benefits of $55.7 million ($0.80 per share). **o** Deficit. **p** After recapitalization on April 27; prior to recapitalization, 45⅝–36¼. **na** = not available.

2 FINANCES OF THE U.S. CHEMICAL INDUSTRY

Year	Net sales	Net income	Total assets	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME % of sales	NET INCOME % of stockholders' equity	NET INCOME $ per share	Dividend, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
						(Money figures in millions of dollars unless otherwise indicated)							
B. F. Goodrich													
1991	$2472	$(80.6)[a]	$2038	$1171.0	$211.2	$ 989	—	—	$(3.50)[a]	$2.20	5.3%	$47⅝–36	—
1990	2433	115.8[b]	2198	1109.3	243.0	1200	4.8%	9.6%	4.20[b]	2.12	5.5	47⅜–29½	9.2
1989	2420	171.2[c]	2103	991.5	240.4	1117	7.1	15.3	6.23[c]	2.00	3.7	69–38½	8.6
1988	2417	209.9[d]	1987	934.4	180.5	1080	8.7	19.4	7.99[d]	1.72	3.5	60¾–37½	6.1
W. R. Grace													
1991	$6049	$219.2[e]	$5698	$2558.2	$447.0	$1744	3.6%	12.6%	$2.51[e]	$1.40	4.4%	$40¾–23⅜	12.8
1990	6754	202.8	5876	2462.1	513.7	1562	3.0	13.0	2.36	1.40	5.5	33⅝–17	10.7
1989	6115	256.6[f]	5321	2220.0	484.6	1433	4.2	17.9	3.01[f]	1.40	4.4	39⅛–25⅛	10.7
1988	5786	192.0[g]	5095	2028.3	418.1	1336	3.3	14.4	2.26[g]	1.40	5.2	29⅞–23½	11.8
Great Lakes Chemical													
1991	$1308	$157.5	$1420	$405.6	$71.2	$672	12.0%	23.4%	$2.23	$0.27	0.6%	$58–30⅜	19.8
1990	1066	140.8	1201	363.7	48.6	538	13.2	26.2	2.00	0.23	0.9	33⅞–20⅜	13.3
1989	792	122.9	935	275.9	40.5	428	15.5	28.7	1.76	0.19	1.0	24–14⅛	10.8
1988	558	103.3	612	234.4	47.0	431	18.5	24.0	1.48	0.17	1.2	16½–12⅛	9.7
Hercules													
1991	$2929	$94.9	$3467	$1476.3	$214.5	$1918	3.2%	4.9%	$2.01	$2.24	5.5%	$50⅜–31¾	20.4
1990	3200	96.0	3700	1449.9	272.6	1942	3.0	4.9	2.04	2.24	6.7	41½–25⅝	16.5
1989	3092	(96.4)[h,i]	3653	1416.5	292.6	1897	–	—	(2.09)[h,i]	2.24	4.9	52¼–38⅜	—
1988	2802	120.4	3325	1164.1	251.0	2045	4.3	5.9	2.55	2.00	4.1	54–42⅝	18.9
Imcera Group													
1991[j]	$1634	$97.2[k]	$1884	$630.2	$123.4	$718	5.9%	13.5%	$1.37[k]	$0.33	1.0%	$42⅞–22⅜	23.8
1990[j]	1425	58.9[l]	1751	585.8	85.7	445	4.1	13.2	0.84[l]	0.33	1.6	25–16	24.4
1989[j]	983	110.3[m]	1753	480.2	82.2	670	11.2	16.5	1.40[m]	0.33	2.1	18½–12⅝	11.1
1988[j]	1471	103.9[n]	1589	445.8	69.1	823	7.1	12.6	1.10[n]	0.33	2.2	17⅛–12⅜	13.4
IMC Fertilizer Group													
1991[j]	$1131	$95.8	$1739	$1220.9	$168.5	$699	8.5%	13.7%	$3.85	$1.08	2.3%	$60–33	12.1
1990[j]	1106	82.6	1585	1144.1	94.3	820	7.5	10.1	3.13	1.08	3.0	39¾–31⅛	11.3
1989[j]	1222	137.3	1678	1144.1	55.3	765	11.2	17.9	5.27	1.02	2.5	49¾–32½	7.8
1988[j,o]	1086	111.7	1472	780.0	26.3	676	10.3	16.5	3.88	0.37	1.1	45⅛–22½	8.7
International Flavors & Fragrances													
1991	$1017	$168.7	$1217	$289.6	$54.1	$960	16.6%	17.6%	$4.41	$2.40	2.8%	$104⅞–68¾	19.7
1990	963	156.7	1129	266.9	42.9	898	16.3	17.4	4.11	2.16	3.3	75⅛–54⅝	15.8
1989	870	138.6	969	236.5	34.2	765	15.9	18.1	3.65	1.92	3.0	77½–48½	17.3
1988	840	128.7	882	228.2	40.8	695	15.3	18.5	3.40	1.60	3.3	54½–43⅛	14.4
Lawter International													
1991	$153	$26.5	$178	$34.3	$8.9	$117	17.3%	22.7%	$0.61	$0.35	3.2%	$13¾–7⅞	17.7
1990	150	23.4	153	28.6	6.2	105	15.6	22.3	0.54	0.29	3.9	8½–6½	13.7
1989	136	19.5	134	24.4	3.1	88	14.3	22.2	0.45	0.29	4.1	7¾–6⅜	15.6
1988	126	20.9	125	24.5	4.5	80	16.6	26.2	0.49	0.29	4.2	7⅞–6	14.1
Loctite													
1991	$561	$71.9	$447[p]	$120.6	$33.5	$279	12.8%	25.8%	$1.98	$0.68	1.7%	$50⅛–28	19.7
1990	555	67.4	458	104.0	29.4	289	12.1	23.3	1.86	0.59	2.3	30¾–20⅝	13.8
1989	474	58.2	402[p]	82.2	23.6	260[p]	12.3	22.4	1.62	0.53	2.5	25½–16⅜	12.9
1988	439	47.6	357[p]	70.1	15.0	223[p]	10.9	21.3	1.33	0.37	2.2	19½–13½	12.4
Lubrizol													
1991	$1468	$123.7	$1154	$380.0	$82.4	$777	8.4%	15.9%	$3.57	$1.54	3.0%	$59½–44	14.5
1990	1445	127.1[q]	1097	353.6	77.4	718	8.8	17.7	3.55[q]	1.46	3.6	49–33	11.5
1989	1220	94.0	960	316.5	64.7	663	7.7	14.2	2.52	1.38	3.5	45⅛–34⅛	15.7
1988	1117	131.2[r]	971	298.7	54.6	664	11.7	19.8	3.40[r]	1.30	3.6	42⅜–30	10.6
Monsanto													
1991	$8864	$296.0[s]	$7937	$3362.0	$591.0	$2364	3.3%	12.5%	$2.33[s]	$2.045	3.4%	$76–46	26.2
1990	8995	546.0[t]	7811	3492.0	750.0	2664	6.1	20.5	4.23[t]	1.88	3.8	60⅛–38¾	11.7
1989	8681	679.0[u]	6922	3173.0	607.0	2259	7.8	30.1	5.02[u]	1.65	3.2	62⅛–40¼	10.2
1988	8293	591.0	6671	3146.0	590.0	2010	7.1	29.4	4.14	1.475	3.6	46⅛–36¾	10.0

a Net loss. **b** From continuing operations; excludes income from discontinued operations of $20.5 million ($0.25 per share). **c** From continuing operations; excludes net income from discontinued operations of $1.2 million ($0.04 per share). **d** From continuing operations; excludes net loss from discontinued operations of $12.1 million ($0.45 per share) and net gain from cumulative effect of change in accounting for income taxes of $2.7 million ($0.11 per share). **e** From continuing operations; excludes net loss from discontinued operations of $0.6 million ($0.01 per share). **f** From continuing operations; excludes net loss from discontinued operations of $3.4 million ($0.04 per share). **g** From continuing operations; excludes net income from discontinued operations and net gain from cumulative effect of accounting change of $41.6 million ($0.49 per share). **h** Net loss. **i** Excludes net gain from cumulative effect of accounting changes of $15.0 million ($0.33 per share). **j** Fiscal year ends June 30. **k** From continuing operations; excludes net loss from discontinued operations of $9.0 million ($0.38 per share). **l** From continuing operations; excludes net gain on sale of fragrance business, after taxes, of $5.2 million ($0.08 per share) and charges from environmental and litigation costs related to previously sold operations of $7.6 million ($0.12 per share). **m** From continuing operations; excludes net gain from discontinued operations of $6.7 million ($0.10 per share). **n** From continuing operations; excludes net loss on disposal of discontinued operations of $5.0 million ($0.06 per share) and extraordinary credit of $16.2 million ($0.18 per share). **o** IMC Fertilizer Group, previously the fertilizer business group of International Minerals & Chemical Corp., became an independent, privately owned company on Feb. 2, 1988. **p** Not adjusted for intangible assets. **q** From continuing operations; excludes gain, after taxes, on sale of Genentech stock of $62.9 million ($1.79 per share) but includes charge for write-off of inventories and receivables due from a former affiliate of $9.7 million. **r** Includes credit for patent litigation settlement, before taxes, of $81.2 million but excludes net credit from cumulative effect of change in accounting for income taxes of $8.8 million ($0.22 per share). **s** Includes net restructuring expense of $325.0 million ($2.54 per share). **t** Includes net gain on divestitures of $56 million ($0.43 per share). **u** Includes net gain on sale of analgesics business of $36 million ($0.27 per share).

Year	Net sales	Net income	Total assets	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME % of sales	NET INCOME % of stockholders' equity	NET INCOME $ per share	Dividend, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
					(Money figures in millions of dollars unless otherwise indicated)								
Morton International													
1991[a]	$1906	$138.3	$1685	$722.3	$163.6	$741	7.3%	18.7%	$2.85	$0.94	1.9%	$58¼–38⅝	17.0
1990[a]	1639	129.0[b]	1448	646.2	113.3	642	7.9	20.1	2.68[b]	0.86	2.3	44¾–31½	14.2
1989[a]	1407	122.1[c]	1170	553.4	131.9	706	8.7	17.3	2.55[c]	—	—	41⅞–37½	15.6
1988[a]	1248	116.4[d]	995	478.6	97.7	606	9.3	19.2	2.43[d]	0.82[e]	2.0[e]	46–35⅝[e]	—
NL Industries													
1991	$840	($24.0)[f,g]	$1831	$738.6	$195.1	($58)[h]	—	—	$(0.40)[f,g]	$0.60	4.8%	$16¾–8½	—
1990	907	93.5[i]	1967	577.1	195.3	39	10.3%	242.4%	1.42[i]	0.60	3.5	24¾–9¼	12.0
1989	1001	170.2[j]	1512	380.5	83.4	137	17.0	124.0	2.57[j]	0.60	2.6	28–18¾	9.1
1988[k]	1007	134.2[l]	837	344.0	70.6	151	13.3	88.9	2.02[l]	0.20[m]	3.1	7¾–5¼	—
Nalco Chemical													
1991	$1237	$134.6[n]	$1186	$493.6	$136.8	$390	10.9%	34.5%	$1.78[n]	$0.83	2.4%	$42¼–26⅛	19.2
1990	1212	131.1	992	419.3	114.9	410	10.8	31.9	1.71	0.755	2.9	30⅝–22	15.4
1989	1071	119.9	892	350.9	86.4	397	11.2	30.2	1.50	0.68	3.2	25–17¼	14.3
1988	994	106.0	795	311.2	61.6	434	10.7	24.4	1.35	0.645	3.6	20–15⅝	13.2
Olin													
1991	$2275	$67.0[o]	$1880	$899.0	$177.0	$534	2.9%	12.5%	$3.32[o]	$2.20	5.0%	$54–33½	13.2
1990	2592	84.0	1760	829.0	187.0	609	3.2	13.8	4.03	2.15	4.8	60⅝–28⅛	10.7
1989	2509	124.0	1794	781.0	142.0	555	4.9	22.3	6.02	1.95	3.3	68¼–49⅜	10.2
1988	2308	98.0	1799	801.0	147.0	542	4.2	18.1	4.63	1.70	3.4	60–40	10.8
Quantum Chemical													
1991	$2532	$(123.3)[f]	$3124	$1987.2	$160.8	($278)[h]	—	—	$(4.26)[f]	$0.00	—	$19¾–9⅛	—
1990	2656	21.2	3139	2020.2	458.4	(183)[h]	0.8%	—	0.79	0.00[p]	—	31⅜–8⅛	12.7
1989	2671	114.1[q]	2910	1759.3	583.3	(266)[h]	4.3	—	4.45[q]	2.18[r]	3.3%	107⅛–28½	14.9
1988	2922	360.1[s]	2881	1308.6	333.5	(433)[h]	12.3	—	13.71[s]	2.40[t]	2.8	108¼–65½	6.3
Rohm & Haas													
1991	$2763	$163.0	$2840	$1470.0	$265.0	$1,174	5.9%	13.9%	$2.45	$1.24	3.1%	$48½–32¾	16.6
1990	2824	207.0[u]	2645	1390.0	412.0	1176	7.3	17.6	3.10[u]	1.22	4.0	37–24¼	9.9
1989	2661	176.0[v]	2361	1148.0	385.0	1217	6.6	14.5	2.65[v]	1.16	3.4	37½–31	12.9
1988	2535	230.0	2148	935.0	338.0	1113	9.1	20.7	3.46	1.02	3.1	37½–28	9.5
Sigma-Aldrich													
1991	$589	$79.8	$597	$191.7	$26.1	$441	13.5%	18.1%	$1.60	$0.23	0.6%	$53–28	25.3
1990	529	71.2	546	192.4	32.5	368	13.5	19.3	1.44	0.205	0.7	35⅜–25⅜	21.1
1989	441	64.0	472	176.4	51.7	299	14.5	21.4	1.29	0.185	0.7	29¾–21⅜	19.9
1988	375	56.5	540	119.5	35.6	244	15.0	23.2	1.15	0.165	0.7	25⅝–19⅞	19.9
Stepan													
1991	$414	$12.5	$271	$157.1	$33.7	$91	3.0%	13.8%	$2.30	$0.66	2.6%	$29¾–21⅜	11.1
1990	390	14.5	247	143.3	38.4	83	3.7	17.5	2.64	0.58	2.6	27¼–16⅝	8.3
1989	346	7.8	215	122.5	34.1	71	2.3	11.1	1.42	0.53	2.2	29½–17¾	16.6
1988	333	13.4	186	104.7	20.4	67	4.0	20.1	2.39	0.475	2.1	25⅝–19¾	9.5
Sterling Chemicals													
1991[w]	$543	$36.8	$361	$230.6	$34.4	$112	6.8%	32.8%	$0.67	$0.65	11.8%	$7⅛–3⅞	8.2
1990[w]	506	59.1	352	216.0	19.9	108	11.7	54.6	1.07	1.00	14.4	8⅝–5¼	6.5
1989[w]	581	103.9	329	216.4	57.6	110	17.9	94.1	1.77	0.75	5.9	18¾–6⅞	7.2
1988[w]	699	213.8[x]	294	172.9	17.0	91	30.6	236.1	3.56[x]	3.17	—	17¾–14⅛	4.5
Union Carbide													
1991[y]	$4877	$(116.0)[z]	$6705	$2499.0	$400.0	$2118	—	—	$(1.06)[z]	$1.00	5.3%	$22⅝–15⅛	—
1990	7621	308.0[aa]	8587	4325.0	744.0	2227	4.0%	13.8%	2.19[aa]	1.00	5.1	24⅞–14⅛	8.9
1989	8744	573.0	8483	4584.0	785.0	2320	6.6	24.7	4.07	1.00	3.6	33¼–22¾	6.9
1988	8324	662.0	8389	4416.0	671.0	1784	8.0	37.1	4.88	1.15	5.1	28⅜–17	4.6
Witco													
1991	$1631	$73.5	$1129	$474.8	$74.3	$556	4.5%	13.2%	$3.21	$1.78	4.9%	$44–28⅞	11.4
1990	1631	68.0	1136	471.0	90.8	544	4.2	12.5	2.95	1.72	5.6	39⅞–21¾	10.4
1989	1588	35.0	1121	417.2	70.4	554	2.2	6.3	1.60	1.61	4.0	45⅛–34⅝	24.9
1988	1586	71.6[bb]	1096	401.0	72.1	560	4.5	12.8	3.05[bb]	1.39	4.0	38⅜–30⅝	11.3

a Fiscal year ends June 30. **b** Excludes extraordinary net gains of $5.8 million ($0.12 per share). **c** Excludes reorganization and other extraordinary net charges of $25.0 million ($0.52 per share). **d** Excludes net charge for cumulative effect of change in accounting for income taxes of $3.8 million ($0.07 per share). **e** Data for Morton Thiokol, of which Morton International was a part until July 1, 1989. **f** Net loss. **g** Excludes extraordinary net gain of $7.5 million ($0.13 per share). **h** Deficit. **i** Excludes extraordinary net loss of $1.1 million ($0.02 per share). **j** Excludes extraordinary net gain of $2.6 million ($0.04 per share). **k** Restated to reflect restructuring and spin-off of petroleum services business on Dec. 22 (except as noted). **l** From continuing operations; excludes net income from discontinued operations of $21.5 million ($0.32 per share). **m** Before restructuring. **n** From continuing operations; excludes net income from discontinued operations of $3.2 million ($0.04 per share). **o** Excludes special charge for restructuring of operations of $80 million ($4.24 per share). **p** Paid 2% stock dividend. **q** From continuing operations; excludes net income and net gain on sale of oleochemical business of $133.3 million ($5.31 per share). **r** Plus 1% stock dividend. **s** From continuing operations; excludes net income from discontinued oleochemical business of $22.6 million ($0.86 per share). **t** Excludes special dividend declared of $50.00 per share. **u** Includes net gain on sale of surfactant and alkylphenol businesses of $26 million ($0.39 per share), on sale of forest property of $20 million ($0.20 per share), and net loss for write-off of intangible assets in electronic materials business of $187 million ($0.27 per share). **v** Includes net gain on sale of interest in U.K. subsidiary of $15 million ($0.23 per share). **w** Fiscal year ends Sept. 30. **x** Excludes net loss on early extinguishment of debt of $9.0 million ($0.15 per share) and net gain on cumulative effect of change in accounting for income taxes of $8.3 million ($0.14 per share). **y** Excludes industrial gases business, to be spun off during 1992. **z** Net loss. **aa** Includes net loss from sale of 50% interest in carbon product business of $86 million ($0.61 per share) and net gain from sale of other businesses of $80 million ($0.57 per share). **bb** Excludes net gain on cumulative effect of accounting change of $20.3 million ($0.81 per share).

2 FINANCES OF THE U.S. CHEMICAL INDUSTRY

Year	Net sales	Net income	Total assets	Net plant and equipment	Capital expenditures	Stockholders' equity	NET INCOME % of sales	NET INCOME % of stockholders' equity	NET INCOME $ per share	Dividends, $ per share	Dividend yield, % of price	Stock price range, $ per share	Price-earnings ratio
					(Money figures in millions of dollars unless otherwise indicated)								
PHARMACEUTICALS													
Abbott Laboratories													
1991	$6,877	$1088.7[a]	$6,255	$2662.1	$770.6	$3203	15.8%	34.0%	$1.28[a]	$0.50	1.8%	$34¾–19⅝	21.3
1990	6,159	965.8	5,563	2375.8	641.4	2834	15.7	34.1	1.11	0.42	2.2	23¼–15⅝	17.5
1989	5,380	859.8	4,852	2090.2	573.1	2726	16.0	31.5	0.96	0.35	2.4	17½–11½	15.1
1988	4,937	752.0	4,825	1952.6	521.2	2465	15.2	30.5	0.84	0.30	2.5	13–10⅝	14.3
American Home Products													
1991	$7,079	$1375.3	$5,684	$1476.8	$227.9	$3046	19.4%	45.2%	$4.36	$2.375	3.6%	$86¼–47⅛	15.3
1990	6,775	1230.6[b]	5,354	1437.4	247.7	2392	18.2	51.4	3.92[b]	2.15	4.3	55–44	12.6
1989	6,747	1102.2	5,114	1481.7	250.7	1403	16.3	78.6	3.54	1.95	4.1	54½–40⅛	13.4
1988	5,501	932.2	3,967	1309.3	344.5	2332	16.9	40.0	3.19	1.80	4.6	42⅛–35½	12.2
Bristol-Myers Squibb													
1991	$11,159	$2056.0	$9,246	$2936.0	$633.0	$5625	18.4%	36.6%	$3.95	$2.40	3.2%	$89⅜–61⅛	19.1
1990	10,300	1748.0	9,023	2631.0	526.0	5226	17.0	33.4	3.33	2.12	3.6	68–50½	17.8
1989	9,189	747.0[c]	8,273	2350.0	562.0	4860	8.1	15.4	1.43[c]	2.00	3.9	58–44	35.7
1988	8,558	1254.0	8,045	2188.0	471.0	4720	14.7	26.6	2.39	1.68[d]	4.0[d]	46½–38⅛[d]	14.7[d]
Johnson & Johnson													
1991	$12,447	$1461.0	$10,513	$3667.0	$987.0	$5626	11.7%	26.0%	$4.39	$1.54	1.7%	$116¼–65⅜	20.7
1990	11,232	1143.0[e]	9,506	3247.0	830.0	4900	10.2	23.3	3.43[e]	1.31	2.1	74⅛–51⅛	18.3
1989	9,757	1082.0	7,919	2846.0	750.0	4148	11.1	26.1	3.25	1.12	2.2	59½–41½	15.5
1988	9,000	974.0	7,119	2493.0	664.0	3503	10.8	27.8	2.86	0.96	2.4	44–34⅝	13.7
Eli Lilly													
1991	$5,726	$1314.7	$7,873	$3782.5	$1,142.4	$4540	23.0%	29.0%	$4.50	$2.00	2.6%	$84⅞–69	17.1
1990	5,192	1127.3	6,674	2936.7	1,007.3	2998	21.7	37.6	3.90	1.64	2.2	89¾–59⅜	19.1
1989	4,176	939.5	5,394	2114.6	554.5	3303	22.5	28.4	3.20	1.35	2.4	68½–42⅜	17.3
1988	3,607	761.0	4,853	1806.6	372.1	2815	21.1	27.0	2.67	1.15	2.8	45¾–35½	15.3
Merck													
1991	$8,603	$2121.7	$9,349	$3504.5	$1,041.5	$4767	24.7%	44.5%	$1.83	$0.77	1.9%	$55⅝–27⅜	22.7
1990	7,671	1781.2	7,873	2721.7	670.8	3677	23.3	48.4	1.52	0.64	2.4	30⅜–22⅜	17.3
1989	6,550	1495.4	6,593	2292.5	433.0	3357	22.8	44.5	1.26	0.55	2.4	26⅞–18¾	18.1
1988	5,939	1206.8	5,992	2070.7	372.7	2720	20.3	44.4	1.02	0.43	2.4	19⅞–16	17.6
Pfizer													
1991	$6,950	$917.1[f]	$9,251	$2381.0	$593.8	$4643	13.2%	19.8%	$2.71[f]	$1.32	2.1%	$86⅛–36¾	22.7
1990	6,406	801.2	8,553	2109.8	547.5	4593	12.5	17.4	2.38	1.20	3.5	40⅞–27¼	14.3
1989	5,671	681.1	7,895	1784.1	456.5	4106	12.0	16.6	2.02	1.10	3.4	37⅞–27	16.1
1988	5,385	791.3	7,218	1655.1	343.7	3882	14.7	20.4	2.35	1.00	3.7	30⅛–23¾	11.4
Schering-Plough													
1991	$3,616	$645.6	$3,822	$1490.4	$339.4	$1155	17.9%	55.9%	$3.01	$1.27	2.4%	$67⅛–40¾	17.9
1990	3,323	565.1	3,937	1284.4	242.9	1915	17.0	29.5	2.50	1.065	2.4	50¾–37	17.6
1989	3,158	471.3	3,440	1210.7	186.1	1782	14.9	26.4	2.09	0.875	2.5	43–27⅝	16.9
1988	2,969	389.9	3,234	1181.0	156.1	1486	13.1	26.2	1.74	0.70	2.7	29⅝–22⅝	15.0
Upjohn													
1991	$3,402	$537.4	$4,147	$1540.7	$258.1	$2005	15.8%	26.8%	$2.96	$1.26	3.0%	$49¼–34¾	14.2
1990	3,021	458.1[g]	3,668	1421.6	246.8	1780	15.2	25.7	2.48[g]	1.04	2.7	44⅝–33	15.7
1989	2,725	323.6[h]	3,232	1275.1	242.3	1736	11.9	18.6	1.74[h]	0.94	2.7	42⅛–27⅝	21.8
1988	2,746	368.7[i]	3,139	1239.6	241.0	1821	12.9	19.4	1.97[i]	0.80	2.6	35¼–26⅞	15.8
Warner-Lambert													
1991	$5,059	$452.8[j]	$3,444	$1350.0	$326.0	$1013	9.0%	44.7%	$4.16[j]	$1.76	2.4%	$82¼–61¾	17.3
1990	4,687	484.9	3,100	1301.4	239.9	1241	10.3	39.1	3.61	1.52	2.5	70⅜–49⅝	16.6
1989	4,196	412.7	2,720	1132.5	218.5	990	9.8	41.7	3.05	1.28	2.6	59⅜–37¼	15.8
1988	3,908	340.3	2,554	1053.0	189.6	850	8.7	40.0	2.50	1.08	3.1	39¾–30	13.9

a Excludes extraordinary net gain on sale of investment in Amgen of $128.2 million ($0.15 per share). b Includes gain on sale of household products and depilatory businesses, before taxes, of $999.5 million. c Includes charges and expenses for integrating operations of Bristol-Myers Co. and Squibb Corp., after taxes, of $693 million ($1.32 per share). d For Bristol-Myers Co. only. e Includes charge for damage to operations in Latin America of $125 million ($0.38 per share). f Excludes special charge for projected payments in connection with potential future Shiley C/C heart valve fractures of $195 million ($0.58 per share). g From continuing operations; excludes loss on discontinued operations and their disposal of $2.4 million ($0.01 per share) but includes partial pension settlement net gain of $37.8 million. h From continuing operations; includes restructuring and other nonrecurring charges of $57.3 million but excludes net loss of discontinued operations and their disposal of $147.6 million ($0.79 per share). i From continuing operations; excludes loss from discontinued operations of $15.3 million ($0.08 per share). j Excludes nonrecurring net charges for restructuring of $418.0 million ($3.11 per share) and for cumulative effect of accounting change of $106.0 million ($0.79 per share).

Chemical employment declined in 1991

In 1991 the recession took its toll on chemical industry employment. After four years of uninterrupted growth, overall employment in the chemicals and allied products industry eased off 1% to an average level for the year of 1.07 million workers. The decline was more severe for all manufacturing, where employment fell 3%, according to the Department of Labor.

Some sectors of the chemical industry were particularly hard hit. Employment in industrial inorganic chemical firms dropped 9% to 126,000 workers. Also hurt by the recession were paint and allied products employees, whose numbers declined 5% to 58,000. Workers in plastics materials and synthetics; soaps, cleaners, and toilet goods; and miscellaneous chemical products each experienced a 2% decline in their numbers. Only the work force of pharmaceutical companies grew last year, by 3% to 245,000.

A look at the Labor Department's monthly data shows that chemical industry employment actually began to fall off about two years ago. The employment cycle peaked in spring 1990 at a seasonally adjusted level of 1.09 million employees. It had dropped to 1.07 million by March 1991 and was still holding steady at that level when the most recent data were collected last month.

Production workers were somewhat harder hit by job losses in the chemical industry than were workers in other parts of the industry. Overall, they posted a 4% loss of jobs in 1991, following a 1% drop in 1990.

As of January 1991, employment of scientists and engineers in the chemical industry was still holding firm. Nearly 80,000 scientists and engineers were working in R&D in the chemical industry then, a 1% rise over January 1990.

Number of workers in chemical industry has eased from 1990 peak

a Seasonally adjusted employment in U.S. chemicals and allied products industry; April and May 1992 figures are preliminary. **Source:** Department of Labor

Drug companies, which employ 43% of the industry's R&D scientists and engineers, had increased their employment by 3% from a year earlier. But employment at industrial chemical firms was up as well, by 1% to 22,300 people.

C&EN's company-by-company compilation of employment at some of the largest chemical companies saw a 3% drop in employment in 1991, following a 2% loss in 1990. Because sales declined for these companies along with employment, sales per employee remained unchanged.

INDUSTRIAL EMPLOYMENT: Many chemical industry sectors lost jobs last year

												% annual change	
Thousands	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1990–91	1981–91
All manufacturing	18,455	19,117	19,442	19,350	19,024	18,965	19,260	19,378	18,434	18,781	20,170	−3%	−1%
Chemicals and allied products	1,072	1,088	1,076	1,059	1,026	1,022	1,044	1,049	1,043	1,075	1,109	−1	0
Industrial inorganic chemicals	126	138	135	133	131	135	143	143	151	161	162	−9	−2
Plastics materials and synthetics	177	181	182	177	168	168	172	178	177	185	196	−2	−1
Drugs	245	237	232	228	215	208	206	206	201	199	199	3	−2
Soap, cleaners, and toilet goods	156	160	161	160	153	147	148	146	142	144	146	−2	1
Paints and allied products	58	61	63	63	63	63	64	62	60	60	63	−5	−1
Industrial organic chemicals	155	155	150	146	148	154	160	162	163	171	178	0	−3
Agricultural chemicals	56	56	54	52	51	54	59	61	61	65	70	0	−2
Miscellaneous chemical products	98	100	100	101	97	94	94	92	89	91	94	−2	0
Petroleum and coal products	159	158	156	160	164	169	179	189	196	201	214	1	−2
Rubber and miscellaneous plastics products	864	890	891	868	843	823	819	814	743	729	772	−3	1

Note: Average annual domestic employment. **Source:** Department of Labor

3 EMPLOYMENT IN THE U.S. CHEMICAL INDUSTRY

PRODUCTION WORKERS: Industrial chemicals and plastics had biggest work force declines

Thousands[a]	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	% annual change 1990–91	% annual change 1981–91
All manufacturing	12,467	12,979	13,269	13,254	12,970	12,877	13,092	13,285	12,530	12,742	14,020	−4%	−2%
Chemicals and allied products	579	601	605	597	575	568	578	583	579	599	628	−4	−1
Industrial inorganic chemicals	62	70	70	69	67	69	72	73	77	86	88	−11	−3
Plastics materials and synthetics	110	116	119	116	111	113	114	117	115	119	130	−5	−1
Drugs	108	105	102	101	99	96	95	96	98	98	99	3	1
Soap, cleaners, and toilet goods	96	99	101	103	98	93	94	93	89	90	92	−3	1
Paints and allied products	30	31	32	31	31	30	31	30	29	29	31	−3	0
Industrial organic chemicals	81	86	88	86	83	81	82	82	84	86	90	−6	−1
Agricultural chemicals	34	34	34	33	32	33	37	38	37	40	44	0	−2
Miscellaneous chemical products	58	59	59	58	55	53	54	54	51	51	54	−2	1
Petroleum and coal products	102	103	102	104	107	106	109	111	118	120	134	−1	−2
Rubber and miscellaneous plastics products	663	689	694	675	654	639	632	633	574	558	597	−4	1

a Average annual domestic employment. **Source:** Department of Labor

EMPLOYMENT OF WOMEN: Growing fastest at industrial inorganic chemical makers

	1990[a]		1980[a]	
	(thousands)	% of total	(thousands)	% of total
All manufacturing	6297.0	33%	6317.0	31%
Chemicals and allied products	329.2	30	277.3	25
Industrial inorganic chemicals	29.9	21	23.9	15
Plastics materials and synthetics	41.4	23	43.9	21
Drugs	106.7	45	82.0	42
Soap, cleaners, and toilet goods	72.5	45	57.3	41
Paints and allied products	12.6	20	12.5	19
Industrial organic chemicals	31.1	20	26.3	15
Agricultural chemicals	9.1	16	10.7	15
Miscellaneous chemical products	26.0	26	20.7	22
Petroleum and coal products	25.8	16	27.0	14
Rubber and miscellaneous plastics products	312.0	35	251.0	33

a Average annual domestic employment. **Source:** Department of Labor

WORKWEEK: Longer for chemical workers, shorter in other fields

Hours[a]	1991	1990	1989
All manufacturing	40.7	40.8	41.0
Chemicals and allied products	42.9	42.6	42.4
Industrial inorganic chemicals	43.6	42.9	42.7
Plastics materials and synthetics	42.6	42.5	43.1
Drugs	42.5	41.8	41.7
Soap, cleaners, and toilet goods	40.9	40.8	40.1
Paints and allied products	41.8	41.9	41.8
Industrial organic chemicals	45.6	45.2	44.6
Agricultural chemicals	44.4	44.1	43.4
Miscellaneous chemical products	42.3	42.4	42.4
Petroleum and coal products	44.1	44.6	44.3
Rubber and miscellaneous plastics products	41.1	41.1	41.4

a For production workers in domestic employment. **Source:** Department of Labor

EMPLOYMENT OF SCIENTISTS, ENGINEERS: Continues to rise in chemical industry

Thousands[a]	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
Total, all industry	709.7	730.9	720.2	708.6	695.8	671.0	622.5	584.1	540.9	509.8	487.8
Chemicals and allied products	79.9	78.9	77.6	75.8	75.2	75.8	71.1	69.8	67.3	61.6	54.7
Drugs and medicines	34.5	33.5	34.0	33.0	32.6	31.8	30.8	30.8[b]	28.2	25.6	23.3
Industrial chemicals	23.3[b]	23.0[b]	23.1[b]	22.5[b]	22.4[b]	24.9	23.5	25.6	26.6	25.9	21.6
Other chemicals	22.1	22.4	20.5	20.3	20.2	19.1	16.7	13.4	12.1	10.1	9.8
Petroleum refining and extraction	10.0	10.2	10.3	9.5	9.9	10.4	13.5	13.3	14.7	15.6	13.0

a Full-time equivalent number of R&D scientists and engineers in industry, as of January of each year. b Partly estimated. **Source:** National Science Foundation

CHEMICAL EMPLOYMENT: Drops to lowest level in decade at major companies

Thousands	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
Air Products	14.6	14.0	14.1	13.3	12.1	16.6	18.7	17.7	16.7	18.9	16.2
American Cyanamid	31.6	32.0	35.4	35.5	34.3	34.5	36.4	38.2	38.7	40.2	41.8
Betz Laboratories	4.0	3.7	3.4	3.1	2.0	2.6	2.5	2.5	2.3	2.2	2.2
Cabot	5.3	6.0	5.5	5.2	5.1	6.6	7.7	7.5	7.2	7.5	7.7
Crompton & Knowles	2.0	1.8	1.7	1.6	1.3	1.3	2.3	2.3	2.4	2.3	2.5
Dow Chemical	62.2	62.1	62.1	55.5	53.1	51.3	53.2	49.8	54.5	56.6	63.8
Ethyl	6.0	5.7	5.5	10.4	10.0	10.5	10.5	11.0	13.0	14.0	14.5
H. B. Fuller	5.6	5.6	5.5	5.2	4.6	4.5	4.4	4.3	4.1	4.0	3.3
B. F. Goodrich	14.4	14.7	11.9	12.3	12.0	11.9	26.2	28.8	29.4	30.0	33.7
W. R. Grace	46.6	49.0	46.4	45.7	39.4	41.4	116.9	102.6	95.5	82.2	89.0
Hercules	17.3	19.9	23.3	22.7	23.2	25.1	25.4	26.3	24.2	24.5	25.9
Imcera Group	9.8	9.6	6.9	6.9	12.9	13.9	8.7	9.0	8.4	8.4	10.6
International Flavors	4.2	4.2	4.2	4.2	4.1	3.8	3.7	3.7	3.7	3.6	3.6
Lubrizol	5.3	5.2	5.3	4.8	4.8	4.8	5.2	4.2	4.2	4.3	4.2
Monsanto	39.3	41.1	42.2	45.6	49.7	51.7	56.1	50.8	48.8	52.2	57.4
Nalco Chemical	6.8	5.9	5.5	5.4	5.1	4.9	5.1	4.8	4.6	4.6	4.7
Olin	14.4	15.2	15.4	16.4	14.1	13.2	14.9	17.8	18.2	17.5	20.3
PPG Industries	33.7	35.1	35.5	36.3	36.8	36.5	37.5	37.7	37.0	37.0	36.6
Rohm & Haas	12.9	12.9	13.0	12.4	12.0	12.1	11.8	11.9	11.4	11.5	13.5
Stepan	1.3	1.3	1.2	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9
Union Carbide	36.7	38.8	46.0	44.0	43.1	50.3	91.5	98.4	99.5	103.2	110.3
TOTAL EMPLOYEES	374.0	383.8	390.0	387.5	380.7	398.4	539.6	530.2	524.7	525.6	562.7
ANNUAL CHANGE	−2.6%	−1.6%	0.6%	1.8%	−4.4%	−26.2%	1.8%	1.0%	−0.2%	−6.6%	−2.5%
SALES PER EMPLOYEE ($ thousands, current)	$205.6	$206.1	$193.6	$186.7	$163.8	$ 138.6	$108.7	116.4	$111.0	$108.9	$110.7
SALES PER EMPLOYEE ($ thousands, constant 1982[a])	$167.2	$166.7	$157.4	$160.6	$154.0	$ 135.1	$104.8	$113.1	$110.7	$108.9	$112.5

Note: Data are not restated for acquisitions, divestitures, or similar developments. a Based on producer price index for chemicals and allied products. **Source:** Company data

WAGES: Rising faster for chemical workers than for workers in other manufacturing areas

	Hourly earnings[a]				Weekly earnings[a]			
	1991	1990	1989	1988	1991	1990	1989	1988
All manufacturing	$11.18	$10.84	$10.47	$10.18	$455.03	$442.27	$429.27	$417.99
Chemicals and allied products	14.07	13.54	13.09	$12.71	603.60	576.80	555.02	536.36
Industrial inorganic chemicals	15.16	14.67	14.19	13.83	660.98	629.34	605.91	590.54
Plastics materials and synthetics	14.81	14.02	13.44	13.06	630.91	595.85	579.26	566.80
Drugs	13.54	12.87	12.51	12.07	575.45	537.97	521.67	496.08
Soap, cleaners, and toilet goods	12.05	11.76	11.28	11.05	492.85	479.81	452.33	444.21
Paints and allied products	12.57	12.01	11.66	11.24	525.43	503.22	484.39	470.96
Industrial organic chemicals	16.54	15.97	15.65	15.30	754.22	721.84	697.99	670.14
Agricultural chemicals	14.18	13.58	12.79	12.35	629.59	598.88	555.09	534.76
Miscellaneous chemical products	12.61	12.30	11.92	11.54	533.40	521.52	505.41	485.83
Petroleum and coal products	17.02	16.23	15.41	14.97	750.58	723.86	682.66	664.67
Rubber and miscellaneous plastics products	10.10	9.79	9.47	9.19	415.11	402.37	392.06	383.22

a For production workers in domestic employment. **Source:** Department of Labor

Smaller work force leads to productivity gains

Productivity in the chemicals and allied products industry improved last year, with this measure of industry health showing its biggest increase in four years. However, unit labor costs also increased as wages for production workers rose faster than output, providing a discordant note to an otherwise moderately good performance. Productivity is measured as output per workhour. Unit labor cost is the cost of labor (wages) per unit of output.

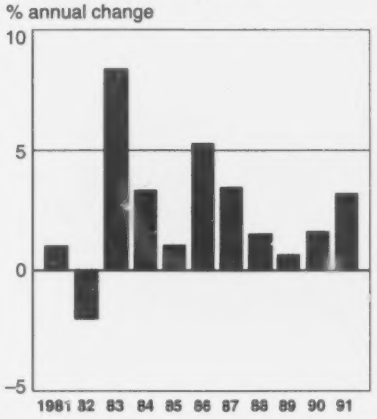
In 1991, productivity for the chemicals and allied products industry increased 3.1%. The gain came, not through a big increase in production, but rather by a decline in workhours within the industry. Production grew just 0.7%, but workhours for production workers declined 2.3% as chemical producers cut employment.

Chemical productivity grew more than productivity for the all-manufacturing category, which is all types of manufacturing industries in the U.S. including the chemical industry. For this umbrella group of all industries, output per workhour rose just 2.1% last year. Unlike chemicals, however, both output and workhours declined for all manufacturing. Production fell 2.1%, and production workhours declined 4.2%.

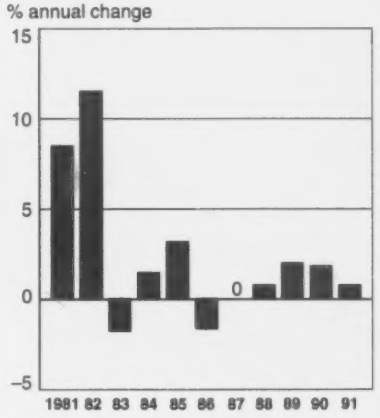
The bad news for chemicals, and indeed for all manufacturing as well, is that while productivity was increasing, so were unit labor costs, which ideally should decline as productivity rises. However, hourly production wages for chemical workers rose 3.8% in 1991, but productivity increased a slower 3.1%. The effect was a rise of 0.8% in the cost of producing each unit of product. The best news that can be derived from this is that it represents the lowest increase in three years.

Nonetheless, the chemical industry controlled its productivity better in 1991 than it did the year before. The 3.1% rise in productivity last year is almost twice that of 1990, when output per workhour rose just 1.6% from the previous year. And the 0.8% increase in unit labor costs in 1991 is less than half the 1.9% increase in 1990.

Chemical productivity increased last year . . .



. . . but unit labor costs also rose



Sources: Federal Reserve Board, Department of Labor, C&EN estimates

PRODUCTIVITY: Shorter workhours made chemical industry more productive in 1991

Indexes, 1987 = 100	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
CHEMICALS AND ALLIED PRODUCTS											
Production	110.9	110.1	108.5	105.4	100.0	94.6	91.4	91.4	87.5	81.8	89.2
Workhours	103.0	105.4	105.4	103.8	100.0	97.8	99.4	100.3	99.2	100.5	107.4
Productivity[a]	107.7	104.5	102.9	101.5	100.0	96.7	92.0	91.1	88.2	81.4	83.1
Hourly production wages	113.7	109.5	105.8	102.3	100.0	96.7	93.6	89.8	85.7	80.6	73.7
Unit labor costs[b]	105.6	104.8	102.8	100.8	100.0	100.0	101.7	98.6	97.2	99.0	88.7
ALL MANUFACTURING											
Production	107.5	109.9	108.9	105.8	100.0	94.3	91.6	89.3	80.9	76.6	80.3
Workhours	95.2	99.4	102.2	102.9	100.0	98.5	99.7	101.5	94.4	93.1	104.8
Productivity[a]	112.9	110.6	106.6	102.8	100.0	95.7	91.9	88.0	85.7	82.8	76.6
Hourly production wages	112.8	109.3	106.1	102.9	100.0	98.3	95.9	92.8	89.3	86.0	80.9
Unit labor costs[b]	100.0	98.8	99.5	100.1	100.0	102.7	104.3	105.4	104.2	103.9	105.6

a Productivity is output per workhour, calculated by dividing indexes for production by indexes for workhours of production employees. b Unit labor costs are labor costs per unit of output, calculated by dividing indexes for wages by indexes for output per workhour. **Sources:** Federal Reserve Board, Department of Labor, C&EN estimates

Recession dampened chemical markets

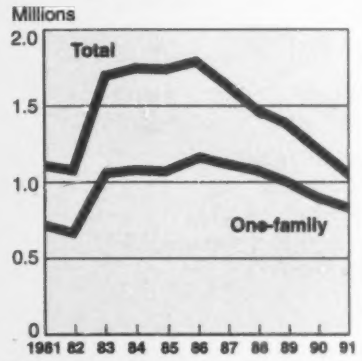
Markets for chemicals were not immune to the general downturn in the economy during 1990 and 1991. As these two pages graphically show, many of the key markets for chemicals and allied products declined last year. And for several of the most important ones, this downturn was only a continuation of a falloff that began several years earlier.

With the economy as a whole in recession, it's not surprising that chemical manufacturers, whose output finds its way into such a vast array of final products, have been affected. The gross national product edged up a mere 3% in 1991, about 1% less than the inflation rate. Personal consumption, which is the ultimate market for much of the chemical industry, did only slightly better—it managed to just keep pace with inflation for the year.

Some of the chemical industry's most important markets did much worse than that. New housing—a major market for plastics, synthetic fibers, and coatings—dropped to its lowest level in a decade in its fifth straight year of decline. Housing starts fell 15% last year to only 55% of what they were in 1986. Sales of U.S.-made automobiles—another major market for coatings, plastics, and rubber chemicals—declined 11% last year, so that only two cars were made in the U.S. last year for every three that were made here in 1985.

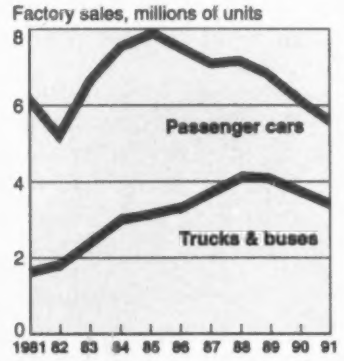
Of the markets presented here, only two—plastics products and paper and paperboard—grew at all last year. And even for these, growth was well below their performance through much of the 1980s.

Housing starts



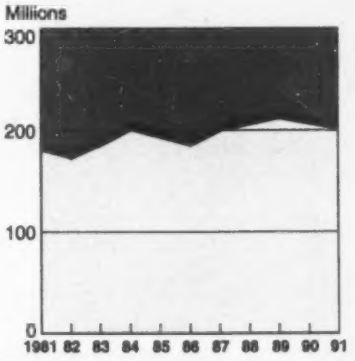
Source: Bureau of the Census

Motor vehicles



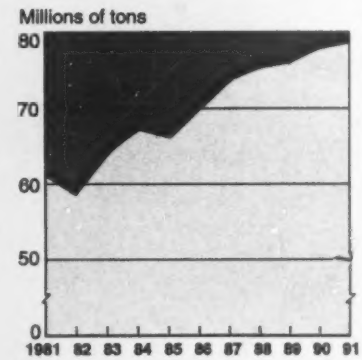
Source: Motor Vehicle Manufacturers Association

Tires and tubes



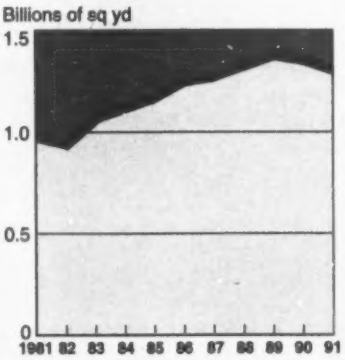
Source: Rubber Manufacturers Association

Paper and paperboard



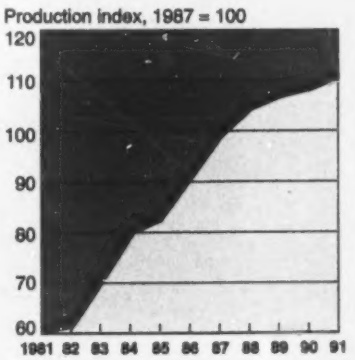
Source: American Paper Institute

Floor coverings



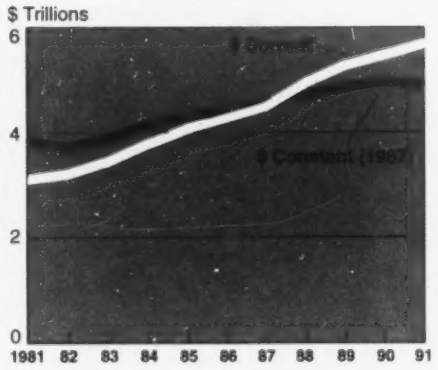
Source: Bureau of the Census

Plastics products



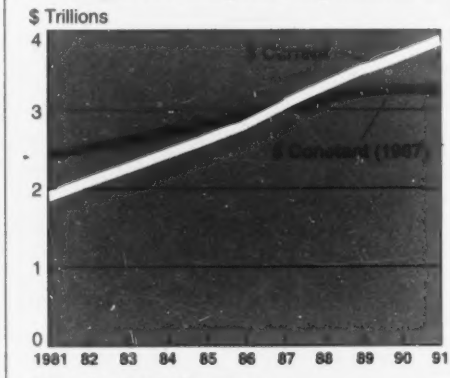
Source: Federal Reserve Board

Gross national product



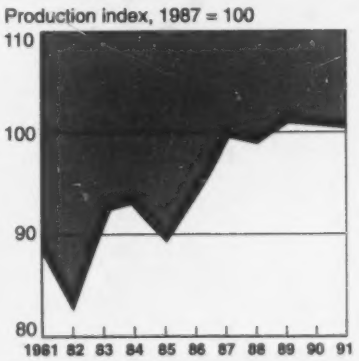
Source: Department of Commerce

Personal consumption expenditures



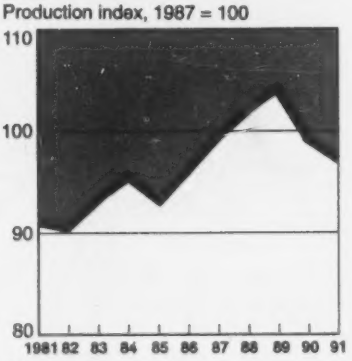
Source: Department of Commerce

Textile mill products



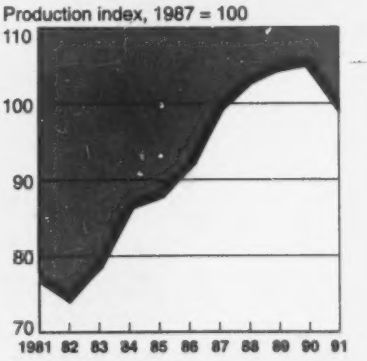
Source: Federal Reserve Board

Apparel



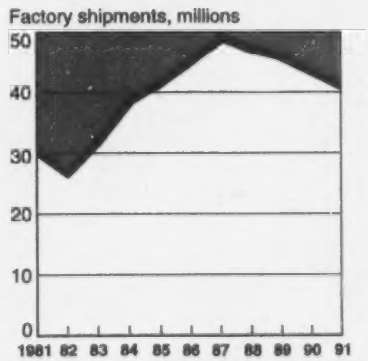
Source: Federal Reserve Board

Furniture and fixtures



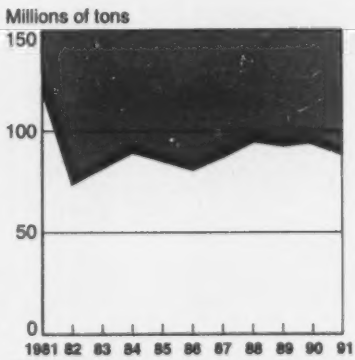
Source: Federal Reserve Board

Major home electrical appliances



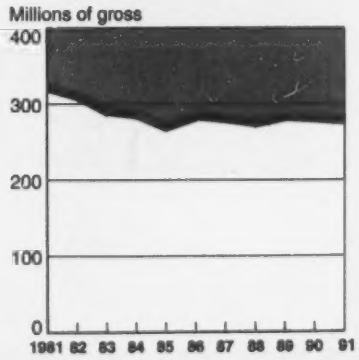
Source: Association of Home Appliance Manufacturers

Steel



Source: American Iron & Steel Institute

Glass containers



Source: Bureau of the Census

U.S. chemical trade posts banner year

What can we do for an encore? That's the big question on the minds of many U.S. chemical traders after the excellent performance they turned in last year. In fact, 1991 was an excellent year for all U.S. trade, not just chemicals.

Total U.S. exports jumped 7% to $422 billion. Meanwhile, imports actually declined—something they haven't done since the recession in 1982. And the overall trade deficit ($66 billion) dropped below the $100 billion mark for the first time since 1983.

But as impressive as these overall trade figures are, they pale by comparison to last year's chemical trade performance. Chemical exports climbed 10% to almost $43 billion—the sixth successive record high. Chemical imports also set a new record last year, increasing 8% to $24.2 billion.

But that export-import combination pushed the chemical trade surplus to an all-time high of $18.8 billion and marked 1991 as the sixth year in a row that the chemical trade surplus established a new record. Only the $27 billion trade surplus of aircraft manufacturers topped the chemical trade surplus last year.

Putting the chemical industry's trade performance in perspective, it has chalked up a cumulative surplus of more than $138 billion since 1980, despite recessions and periods when the dollar was strong, which hurt exports. During the same period, overall U.S. trade has accumulated a deficit of more than $1 trillion. It has not enjoyed a single year in which it had a surplus during that time.

With the understandable exception of the former East European bloc, U.S. chemical exports last year were strong to all areas of the world. As a result, the U.S. share of world chemical exports jumped a full percentage point—to 15%. But there are signs that the chemical trade surplus may be topping out. During the last few months of 1991 and the first few months of this year, the chemical trade balance has been slipping a little.

U.S. TOTAL TRADE BALANCE: Trade deficit drops sharply

$ Billions	1991	1990	1989	1988	% annual change 1990–91
Total exports	$ 421.9	$ 394.0	$ 364.3	$ 322.4	7%
Total imports	488.1	495.0	472.9	440.9	−1
Trade balance	−66.2	−101.0	−108.6	−118.5	−35

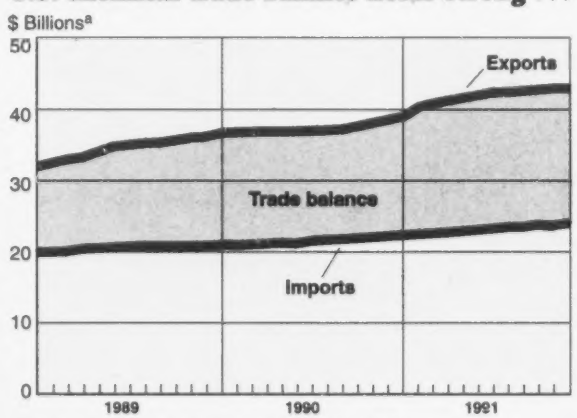
Source: Department of Commerce

U.S. CHEMICAL TRADE BALANCE: Chemical surplus sets another record

$ Millions	1991	1990	1989	1988	% annual change 1990–91
Chemical exports	$42,967	$38,983	$36,485	$31,909	10%
Chemical imports	24,169	22,468	20,752	20,326	8
Chemical trade balance	18,798	16,515	15,733	11,583	14

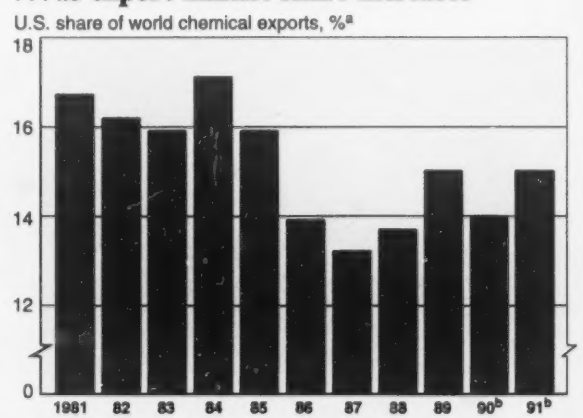
Note: Data for 1990, 1989, and 1988 have been revised according to SITC (Standard International Tariff Classification) revision 3. Earlier data have not been revised. **Source:** Department of Commerce

U.S. chemical trade balance holds strong . . .



a Running 12-month totals. **Source:** Department of Commerce

. . . as export market share increases



a U.S. chemical exports as a percentage of total world chemical exports less U.S. chemical imports. b C&EN estimates.

U.S. CHEMICAL TRADE: Exports to developing areas fuel overall growth

$ Millions	1991		1990		1989		1988		% annual change, 1990–91	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
European Community	$11,250	$10,418	$10,509	$ 9,728	$ 9,758	$ 9,158	$ 8,318	$ 9,066	7%	7%
Rest of Asia	7,172	1,445	6,566	1,267	6,624	985	5,712	844	9	14
Latin America	6,590	1,333	5,773	1,287	5,419	1,671	5,083	1,354	14	4
Canada	6,555	4,352	6,050	4,305	4,210	3,934	3,751	3,841	8	1
Japan	5,047	2,706	4,582	2,391	4,664	2,373	3,982	2,399	10	13
Communist Asia	1,671	392	1,054	337	1,136	273	1,309	230	59	16
Australia	1,357	421	1,247	344	1,364	291	1,066	329	9	22
Africa	715	95	628	90	702	61	594	106	14	6
Middle East	673	372	629	355	543	371	542	305	7	5
Eastern Europe	387	263	460	242	409	208	336	219	−16	9
Other	1,550	2,372	1,485	2,122	1,656	1,427	1,216	1,633	4	12
TOTAL	**$42,967**	**$24,169**	**$38,983**	**$22,468**	**$36,485**	**$20,752**	**$31,909**	**$20,326**	**10%**	**8%**

Source: Department of Commerce

WORLD CHEMICAL TRADE: Growth slows, despite gains by U.S. and Japan

$ Millions	1991		1990		1989		1988		% annual change, 1990–91	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
EC, 12 countries	$166,426	$143,914	$165,219	$141,643	$141,930	$119,022	$139,894	$112,497	1%	2%
Germany[a]	51,010	32,729	50,597	30,854	44,187	25,387	43,848	24,274	1	6
France	28,800	24,527	28,339	24,965	23,941	20,721	23,634	19,619	2	−2
U.K.	24,488	19,370	23,594	19,317	20,189	17,091	20,187	16,583	4	0
Netherlands	21,080	13,068	22,478	13,254	19,494	11,539	19,617	10,828	−6	−1
Belgium-Luxembourg	16,648	13,877	16,447	13,701	13,889	11,514	13,043	10,672	1	1
Italy	11,354	20,109	11,152	20,260	9,944	17,167	10,170	16,081	2	−1
U.S.	42,967	24,169	38,983	22,468	36,485	20,752	31,909	20,326	10	8
Japan	17,475	17,412	15,872	16,045	14,776	15,948	13,964	14,830	10	9
Switzerland	12,882	7,195	13,776	8,035	11,008	6,679	11,137	6,731	−7	−11
Canada	6,465	7,859	6,600	7,753	6,098	7,192	6,230	6,577	−2	1
WORLD	**$310,500[b]**	**$310,500[b]**	**$ 301,500[b]**	**$301,500[b]**	**$264,416**	**$264,416**	**$253,503**	**$253,503**	**3%**	**3%**

a Data prior to 1990 are for West Germany only. b C&EN estimates. **Sources:** United Nations, Organization for Economic Cooperation & Development, European Community, individual government agencies

U.S. TRADE, BY PRODUCTS: Exports of plastics and perfumes were big gainers last year

$ Millions	1991		1990		1989		1988		% annual change, 1990–91	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Organic chemicals	$10,928	$ 8,157	$10,400	$7,392	$10,609	$ 7,042	$ 9,704	$ 7,250	5%	10%
Plastics in primary form	7,537	1,930	6,428	1,974	5,727	1,687	5,503	1,373	17	−2
Medicinals and pharmaceuticals	4,606	3,053	4,103	2,500	3,660	2,086	3,262	1,849	12	22
Inorganics	4,102	3,299	3,816	3,234	4,319	3,231	4,289	3,147	8	2
Fertilizers, manufactured	2,980	919	2,574	955	2,821	999	1,199	991	16	−4
Plastics in nonprimary form	2,786	1,855	2,633	1,774	2,202	1,629	2,001	1,574	6	5
Essential oils and perfume materials	2,361	1,417	1,963	1,323	1,469	1,165	1,126	1,175	20	7
Dyeing, tanning, and coloring materials	1,648	1,416	1,588	1,288	1,097	1,133	1,100	1,302	4	10
Other	6,020	2,123	5,478	2,028	4,583	1,780	3,725	1,665	10	5
TOTAL	**$42,967**	**$24,169**	**$38,983**	**$22,468**	**$36,485**	**$20,752**	**$31,909**	**$20,326**	**10%**	**8%**

Source: Department of Commerce

Sluggish year for West European chemicals

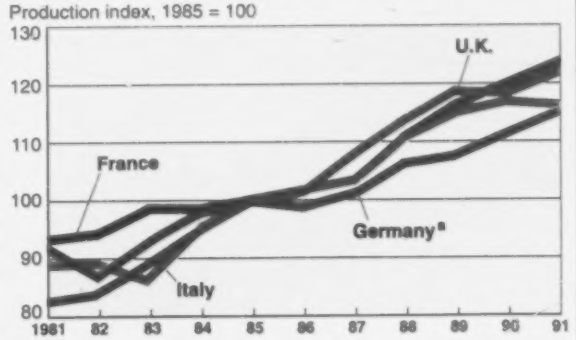
The chemical industry in Western Europe may have outpaced its counterpart in the U.S. in 1991, but just barely. Combined sales for the chemical producers of the 15 countries of the region edged up 2% last year, based on local currency sales figures. Chemical production increased modestly, too, for several of the key chemical-producing countries of the region, such as Germany, France, and the U.K. However, as in the U.S., profits were generally down for the second year in a row for chemical makers, and overall chemical employment in the 15 countries dropped 1%.

The biggest chemical-producing countries were generally the only ones to post gains last year. Chemical sales for Germany, France, and the U.K., which together account for just over half of Western Europe's chemical business, grew by $6.5 billion in 1991, a 3% increase, to reach $217 billion. Chemical sales from the other 12 nations, though they account for 47% of the region's chemical sales, rose only $200 million last year, to $194.4 billion.

And even production of many big-volume chemicals declined a bit. In Germany, for example, production of sulfuric acid fell 7%, chlorine fell 5%, and sodium hydroxide fell 4%. Among organic chemicals, propylene production rose 1% for the year, and ethylene output was unchanged. (Data for Germany here and in the accompanying tables and graphs include only the states of the former West Germany. Although the German government is working to integrate statistics from its eastern and western regions, data from the former East German states remain too sketchy to include in this report.)

The composition of the West European chemical industry, as far as major companies go, remained the same in 1991, although Germany's Hoechst nosed out BASF as the largest in terms of sales. Both income and profit margins throughout the industry continued to suffer, primarily because of soft prices. At Hoechst, for example, earnings were down 20% from 1990 levels, despite a 5% gain in sales. In fact, almost the only companies posting profit gains last year were those with extensive drug-making operations, such as Switzerland's Ciba-Geigy, Sandoz, and Roche Group.

U.K. chemical output recovers, Italy's stalls



a Includes only former West Germany.
Source: European Chemical Industry Council (CEFIC)

CHEMICAL INDUSTRY TRENDS: Sales growth slows as some prices fall

$ Billions (U.S.)	1991	1990	1989	1988	1987
GERMANY[a]					
Sales	$ 99.9	$ 98.1	$ 96.5	$ 90.9	$ 84.6
Exports	50.1	50.2	51.8	48.2	43.6
Imports	34.6	32.4	30.9	27.1	24.5
Capital spending	7.8	7.5	6.9	6.4	5.7
Production index[b]	114.8	112.4	109.4	106.5	101.1
Price index[b]	93.2	93.8	95.2	92.4	91.1
Employees (thousands)	594	592	582	575	572
FRANCE[c]					
Sales	$ 66.1	$ 63.9	$ 61.3	$ 56.5	$ 50.5
Exports	27.0	25.8	25.8	23.1	20.2
Imports	22.8	22.7	21.9	19.2	16.4
Capital spending	4.1	4.1	3.5	3.1	2.7
Production index[b]	123.7	120.3	118.2	111.4	104.1
Price index[b]	103.2	103.2	103.2	98.8	96.3
Employees (thousands)	265	263	264	257	268
U.K.[c]					
Sales	$ 51.0	$ 48.5	$ 48.3	$ 43.8	$ 39.8
Exports	24.7	23.6	22.1	20.1	18.7
Imports	19.5	19.2	18.5	16.5	14.8
Capital spending	3.3	3.6	3.3	3.1	2.5
Production index[b]	121.9	118.3	119.3	113.9	109.0
Price index[b]	126.5	121.7	116.4	111.5	105.8
Employees (thousands)	303	324	323	320	336

$ Billions (U.S.)	1991	1990	1989	1988	1987
ITALY					
Sales	$ 50.3	$ 50.2	$ 48.9	$ 46.0	$ 39.2
Exports	12.5	12.5	12.7	11.4	9.7
Imports	21.2	20.9	20.3	17.9	15.4
Capital spending	3.0	2.9	2.7	2.2	1.9
Production index[b]	115.9	117.1	115.0	112.5	103.6
Price index[b]	120.4	117.5	110.7	107.5	100.4
Employees (thousands)	217	217	220	223	225
SPAIN[c,d]					
Sales	$ 38.4	$ 39.0	$ 37.0	$ 34.1	$ 30.7
Exports	6.3	6.1	5.9	5.5	5.0
Imports	11.5	10.5	9.8	8.5	7.5
Capital spending	1.0	1.2	1.0	0.8	0.6
Production index[b]	130.9	132.5	128.6	122.5	112.4
Price index[b]	111.8	112.1	108.3	104.6	102.5
Employees (thousands)	240	240	240	239	239
BELGIUM[c,d,e]					
Sales	$ 27.9	$ 27.4	$ 26.9	$ 24.4	$ 21.6
Exports	20.9	20.2	19.9	17.6	16.0
Imports	17.6	17.0	16.5	14.5	11.7
Capital spending	2.7	3.1	2.1	1.7	1.1
Production index[b]	129.9	128.4	124.9	120.2	110.6
Price index[b]	98.1	98.8	102.1	96.5	94.0
Employees (thousands)	99	97	95	92	91
NETHERLANDS					
Sales	$ 24.3	$ 24.6	$ 25.4	$ 23.7	$ 21.2
Exports	23.1	23.5	25.1	23.1	20.6
Imports	13.9	13.8	17.2	13.3	12.5
Capital spending	2.3	2.0	2.3	1.6	1.6
Production index[b]	120.0	120.0	118.0	112.0	104.0
Price index[b]	87.0	89.0	92.0	88.0	87.0
Employees (thousands)	92	93	93	92	91
SWITZERLAND					
Sales	$ 15.6	$ 15.0	$ 14.5	$ 13.0	$ 12.0
Exports	13.3	12.9	12.5	11.0	10.2
Imports	7.4	7.4	7.6	6.5	5.8
Production index[b]	120.6	119.6	119.0	109.4	105.3
Price index[b]	97.9	97.9	93.0	91.9	90.8
Employees (thousands)	72	73	72	70	69
SWEDEN					
Sales	$ 7.8	$ 8.2	$ 7.8	$ 7.6	$ 6.6
Exports	4.7	4.2	3.9	3.6	3.1
Imports	5.1	5.1	5.0	4.7	4.1
Capital spending	0.7	0.7	0.5	0.5	0.5
Production index[b]	109.0	118.5	115.0	119.6	106.3
Price index[b]	122.0	118.0	116.0	110.5	103.2
Employees (thousands)	40	42	42	43	45

$ Billions (U.S.)	1991	1990	1989	1988	1987
AUSTRIA[d]					
Sales	$ 7.7	$ 7.8	$ 7.9	$ 7.4	$ 6.8
Exports	3.6	3.4	3.4	3.2	2.7
Imports	4.9	4.8	4.4	4.0	3.8
Capital spending	0.8	0.9	0.7	0.6	0.6
Production index[b]	105.2	105.4	103.8	100.0	87.3
Employees (thousands)	54	57	57	56	55
PORTUGAL					
Sales	na	$ 5.4	$ 5.0	$ 4.8	$ 1.7
Exports	$ 0.8	0.6	1.0	0.8	0.6
Imports	2.1	1.9	2.3	1.9	1.8
Production index[b]	na	na	172.2	163.2	151.9
Employees (thousands)	na	na	64	51	51
IRELAND[c]					
Sales	$ 5.1	$ 4.6	$ 4.2	$ 3.3	$ 2.7
Exports	4.3	3.7	3.4	2.6	2.1
Imports	2.8	2.5	2.5	2.1	1.8
Production index[b]	181.5	149.0	144.8	124.1	108.1
Price index[b]	91.1	92.5	96.8	93.4	91.7
Employees (thousands)	15	14	13	12	12
DENMARK					
Sales	$ 4.4	$ 4.3	$ 4.4	$ 3.8	$ 4.0
Exports	3.4	3.2	3.6	2.8	2.6
Imports	3.6	3.6	4.0	3.3	3.0
Capital spending	na	0.3	0.4	0.3	0.3
Production index[b]	111.6	110.9	111.0	107.0	105.4
Price index	116.1	112.4	109.0	104.0	99.0
Employees (thousands)	27	27	27	26	26
FINLAND					
Sales	na	$ 4.2	$ 4.2	$ 3.6	$ 3.9
Exports	$ 1.6	1.6	1.6	0.6	0.7
Imports	2.5	2.7	2.8	1.0	1.2
Capital spending	na	0.5	0.4	0.4	0.5
Production index[b]	108.5	116.8	120.2	113.4	92.1
Price index[b]	110.9	109.1	107.8	102.4	95.0
Employees (thousands)	na	20	20	20	24
NORWAY					
Sales	$ 3.3	$ 3.5	$ 3.3	$ 3.1	$ 3.0
Exports	2.1	2.1	2.0	1.9	1.7
Imports	2.3	2.1	2.0	1.9	1.7
Capital spending	na	0.2	0.2	0.2	0.2
Production index[b]	111.5	117.0	108.6	103.0	103.0
Price index[b]	122.5	120.3	122.0	114.0	106.0
Employees (thousands)	14	14	14	14	15

Note: Monetary statistics for all years are converted from local currency to U.S. dollars on the basis of 1991 conversion rates as follows: $1.00 = 11.68 Austrian schillings, 34.25 Belgian francs, 6.40 Danish crowns, 4.04 Finnish marks, 5.64 French francs, 1.66 German marks, 0.619 Irish pounds, 1241 Italian lire, 1.87 Netherlands guilders, 6.48 Norwegian crowns, 144.5 Portuguese escudos, 103.9 Spanish pesetas, 6.05 Swedish crowns, 1.43 Swiss francs, and 0.565 British pounds. **a** Includes former West Germany only. **b** 1985 = 100. **c** Excludes fibers. **d** Includes rubber and plastics processing. **e** Includes Luxembourg for exports and imports. **na** = not available. **Sources:** National agencies, European Chemical Industry Council (CEFIC)

MAN-MADE FIBERS: Cellulosics output down, uneven results for other fibers

Millions of lb	1991		1990		1989		1988		1987		% change, 1990–91	
	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics	Non-cellulosics	Cellulosics
Germany	1767	385	1848	396	1841	394	1817	376	1806	356	−4%	−3%
Italy	1522	79	1450	79	1412	77	1452	70	1441	64	5	0
Benelux countries	605	114	568	117	521	119	385	119	399	109	7	−3
Spain	557	66	585	79	592	88	590	81	591	78	−5	−17
Turkey	na	na	535	20	645	20	592	20	572	18	na	na
U.K.	513	218	506	266	493	255	515	238	513	208	1	−18
France	260	0	343	0	392	4	392	33	382	50	−24	—
Switzerland	224	0	260	0	264	0	255	0	227	0	−14	—
Ireland	205	0	205	0	207	0	176	0	172	0	0	—
Portugal	141	0	141	1	141	2	128	2	139	2	0	—
Austria	84	262	84	297	77	301	70	290	68	264	0	−12
Finland	13	103	11	141	7	143	7	132	4	118	18	−27

na = not available. **Source:** Comité International de la Rayonne et des Fibres Synthétiques

PRODUCTION: Generally down in Germany and Italy, mixed in France and the U.K.

Millions of lb	1991	1990	1989	1988	% change 1990–91
FRANCE					
Sulfuric acid	7970	8306	9141	8846	−4%
Hydrochloric acid	1441	1488	1525	1507	−3
Chlorine	2790	2956	3185	3121	−6
Sodium hydroxide	2933	3143	3370	3258	−7
Carbon black	494	556	595	531	−11
Ammonia	na	3257	3249	4031	—
Benzene	1542	1434	1474	1544	8
Toluene	na	74	74	104	—
Xylenes	na	na	372	493	—
Ethylene	5320	4948	5562	5361	8
Propylene	3546	3157	3480	3298	12
Butadiene	623	619	724	737	1
Formaldehyde	95	220	221	193	−57
Polyethylene	2643	2461	2549	2620	7
Polypropylene	1790	1715	1544	1278	4
Polystyrene	1164	1193	1192	1177	−2
Polyvinyl chloride	2310	2265	2350	2237	2
Synthetic rubber	1036	1151	1300	1251	−10
Nitrogen fertilizers	4026	4655	4373	4343	−14
Phosphate fertilizers[a]	554	626	707	700	−12
GERMANY[b,c]					
Sulfuric acid	6831	7370	7165	7186	−7
Hydrochloric acid	1854	1982	2107	2160	−7
Nitric acid	2957	3936	4807	5098	−25
Chlorine	6795	7175	7574	7701	−5
Sodium hydroxide	6829	7129	7370	7602	−4
Sodium carbonate	3008	3166	3175	3089	−5
Sodium sulfate	300	368	379	385	−19
Carbon black	823	870	884	836	−5
Ammonia	3500	3686	4573	4816	−5
Benzene	3419	3287	3443	3536	4
Toluene	1330	1184	919	1013	12
Xylenes	1155	1276	1345	1296	−10
Aniline	na	na	376	386	—
Ethylene	6790	6773	6588	6889	0
Propylene	4053	4028	3819	3396	1
Butadiene	1494	1714	1579	1677	−13
Ethylene oxide	1282	1386	1482	1381	−8
Ethylene glycol	na	464	543	521	—
Propylene oxide	1328	1302	1299	1209	2
Propylene glycol	387	394	399	427	−2
n-Butanol	766	781	741	685	−2
Acetaldehyde	na	771	709	789	—
Acetic acid	734	713	701	754	3
Ethanol	245	234	224	228	5
Methanol	1660	1656	1535	na	0%
Formaldehyde	1442	1500	1534	1505	−4
Phthalic anhydride	452	507	506	612	−11
Polyethylene	3011	3254	3064	3235	−8
Polyvinyl chloride	2560	2913	2948	3105	−12
Polypropylene	1165	1121	na	na	−4
Synthetic rubber	1126	1154	1119	1101	−4
Nitrogen fertilizers[d]	1363	1816	1500	na	−25
Phosphate fertilizers[a]	150	165	197	na	−9
ITALY[c]					
Sulfuric acid	6246	7190	7084	9478	−13
Nitric acid	2166	2286	2443	2625	−6
Hydrochloric acid	1240	1630	1400	2218	−24
Phosphoric acid	385	497	618	785	−23
Chlorine	1822	2300	2349	2385	−21
Sodium hydroxide	2286	2427	2598	2618	−6
Sodium perborate	266	271	276	242	−2
Carbon black	405	405	446	442	0
Ammonia	2883	3207	3882	3846	−10
Benzene	1151	1351	1447	1368	−15
Toluene	363	423	338	480	−14
Xylenes	750	841	1023	986	−11
Formaldehyde	220	251	258	277	−12
Acetic acid	21	21	99	145	0
Polyethylene	2067	2053	1937	1822	−2
Polystyrene	840	778	590	627	8
Polyvinyl chloride	1360	1362	1801	1740	0
Nitrogen fertilizers[d]	4660	5261	6210	7176	−11
U.K.[c]					
Sulfuric acid[e]	3086	2847	2543	na	8
Hydrochloric acid[e]	345	358	367	388	−4
Chlorine	1952	2073	na	na	−6
Sodium hydroxide[e]	473	346	na	na	37
Benzene	1334	1544	2260	2072	−14
Ethylene	3881	3296	4356	4464	18
Propylene	1857	1653	1757	2985	12
Butadiene	326	436	498	527	−25
Acetone	274	283	287	280	−3
Formaldehyde	102	176	176	246	9
Polyethylene	828	740	989	1015	12
Polypropylene	694	653	657	692	6
Polyvinyl chloride	710	768	736	740	−8
Synthetic rubber	602	657	687	688	−8

a As P_2O_5. b Data are for the former West Germany only. c Data for 1991 are C&EN estimates based on nine months' reporting. d As N. e Manufacturers' sales. na = not available. **Sources:** British Plastics Federation, British Rubber Institute, government agencies for each country

COMPANY RESULTS: Profits rose for drugmakers, fell for most other firms

$ Millions	Net sales	Net income	Profit margin[a]	Capital spending	R&D spending	Employees (thousands)
Hoechst (Germany)						
1991	$28,425.0	$ 817.5	2.9%	$2160.2	$1728.3	179.3
1990	27,025.3	1021.7	3.8	2047.5	1618.6	172.9
1989	27,649.3	1283.1	4.6	1925.8	1578.9	169.3
1988	24,677.1	1213.9	4.9	1674.6	1455.4	164.5
BASF (Germany)						
1991	$28,088.0	$ 625.9	2.2%	$2891.6	$1242.8	129.4
1990	28,086.1	666.8	2.4	2685.6	1242.8	134.6
1989	28,684.9	1214.0	4.2	2383.1	1246.4	137.0
1988	26,426.5	862.8	3.2	2105.4	1177.2	134.8
Bayer (Germany)						
1991	$25,542.8	$1116.3	4.4%	$1851.8	$1811.4	164.2
1990	25,086.2	1146.4	4.6	2221.0	1649.4	171.0
1989	26,083.7	1274.6	4.9	2076.5	1623.5	170.2
1988	24,378.3	1156.0	4.7	1894.5	1481.9	165.7
ICI (U.K.)						
1991	$22,102.7	$ 959.3	4.3%	$1569.9	$1224.8	128.6
1990	22,842.5	1023.0[b]	4.8	1792.9	1201.8	132.1
1989	23,311.5	1646.0[c]	7.1	1911.5	1131.0	133.8
1988	20.706.2	1559.3[d]	7.5	1435.4	1000.0	130.4
Rhône-Poulenc (France)						
1991	$14,861.2	$ 355.3	2.4%	$1371.5	$1017.0	87.0
1990	13,973.5	344.3	2.5	1329.7	939.7	91.6
1989	12,955.4	725.5	5.6	1244.0	749.9	85.6
1988	11,584.1	612.9	5.3	1046.3	677.8	79.7
Ciba-Geigy (Switzerland)						
1991	$14,739.2	$ 895.1	6.1%	$1368.5	$1528.0	91.7
1990	13,778.3	760.1	5.2	1439.2	1434.3	94.1
1989	14,411.2	753.8	7.5	1389.5	1451.0	92.6
1988	12,340.6	659.4	7.5	1130.1	1256.6	88.8
EniChem (Italy)						
1991	$10,817.1	$ (581.8)[e]	—	na	na	na
1990	12,135.3	(54.7)[e]	—	$1477.9	$ 259.5	49.0
1989	12,366.7	577.0	4.7%	1598.1	na	52.7
1988[f]	11,814.7	708.7	6.0	965.4	na	54.7
Norsk Hydro (Norway)						
1991	$ 9,478.9	$ (76.9)[e]	—	$1401.2	$ 136.0	35.0
1990	9,409.3	447.7	4.8%	1260.8	111.6	33.0
1989	10,236.0	414.7	4.1	1762.2	100.2	32.8
1988	9,263.6	530.0	5.7	1363.6	114.2	39.5
Sandoz (Switzerland)						
1991	$ 9,401.4	$ 779.0	8.3%	$ 886.7	$ 928.7	53.4
1990	8,648.3	676.2	7.8	888.1	844.8	52.6
1989	8,739.2	669.9	7.7	752.4	772.0	50.7
1988	7,098.6	532.2	7.5	585.3	637.8	48.0
Akzo (Netherlands)						
1991	$ 9,011.2	$ 363.1[g]	4.0%	$ 538.5	$ 479.1	65.2
1990	9,222.5	382.9[h]	4.2	603.7	476.5	69.8
1989	10,019.3	517.6	5.1	693.6	483.4	70.9
1988	8,866.8	472.2	5.3	679.1	433.2	71.1

$ Millions	Net sales	Net income	Profit margin[a]	Capital spending	R&D spending	Employees (thousands)
Degussa (Germany)						
1991	$8042.2	$ 59.6	0.7%	$ 471.7	$ 291.6	34.5
1990[i]	8388.6	88.5	1.1	410.2	275.9	35.0
1989[i]	8648.8	105.4	1.2	319.8	254.3	33.7
1988[i]	8195.8	88.0	1.1	270.7	226.0	32.4
Solvay (Belgium)						
1991	$7439.4	$ 309.8[j]	4.2%	$ 989.8	$ 375.6	45.6
1990	7452.3	519.7[k]	7.0	1065.7	375.1	45.7
1989	7497.8	603.5[l]	8.0	899.2	350.4	45.1
1988	7400.5	441.1[m]	6.0	691.9	315.0	44.3
Roche Group (Switzerland)						
1991	$8007.7	$1036.4	12.9%	$ 796.5	$1207.7	55.1
1990	6762.2	662.3	9.8	634.3	1009.8	52.7
1989	6862.9	595.8	8.7	635.0	992.3	50.2
1988	6076.9[n]	449.0[n]	7.4	445.9	846.2	47.2[n]
DSM (Netherlands)						
1991	$4998.4	$ 275.9	5.5%	$ 939.0	$ 227.3	25.2
1990	5435.3	459.4[o]	8.0	700.5	227.3	24.9
1989	5760.4	738.0[p]	9.6	930.5	213.9	30.0
1988	5412.3	332.6[q]	7.8	712.3	192.5	28.6
Air Liquide (France)						
1991	$5641.6	$ 391.8	6.9%	$ 773.8	$ 134.2	28.0
1990	5126.7	349.5[r]	6.8	703.1	130.0	na
1989	5009.1	320.2[s]	6.4	533.5	157.8	27.0
1988	4543.8	280.9	6.2	406.7	128.2	na
BOC International (U.K.)						
1991[t]	$4810.6	$ 342.5	7.1%	$ 658.6	$ 112.7	39.7
1990[t]	2643.9	241.9	9.2	308.0	62.2	40.0
1989[t]	2309.1	229.3	9.9	344.8	54.6	38.4
1988[t]	2119.5	205.2[t]	9.7	294.2	46.8	38.8
Nobel Industries (Sweden)						
1991	$4085.5	$ 76.0[u]	1.9%	$ 322.5	na	22.9
1990	4451.7	169.1[v]	3.9	401.5	na	26.7
1989	3650.9	180.3[w]	6.2	239.5	na	22.2
1988	3524.3	100.5	4.4	178.7	na	22.1
Courtaulds (U.K.)						
1991[x]	$3438.2	$ 268.3	7.8%	$ 212.4	$ 70.8	22.7
1990[x]	3383.4	255.8[y]	7.6	na	70.8	24.0
1989[x]	3369.9	223.0[z]	6.6	na	72.4	24.0
1988[x]	2916.8	196.5[aa]	6.7	na	60.0	20.8
Schering Group (Germany)						
1991	$3831.3	$ 165.1[bb]	4.3%	$ 294.0	$ 580.7	26.3
1990	3568.1	155.7[cc]	4.4	308.7	563.1	26.7
1989	3521.0	135.5	3.9	276.4	442.9	25.3
1988	3176.0	94.6	3.0	247.6	379.6	24.7
Kemira (Finland)						
1991	$2685.1	$(141.3)[dd,e]	—	$ 292.1	na	14.3
1990	2817.3	41.3[ee]	1.5%	281.2	na	15.3
1989	2729.7	45.0	1.6	397.3	na	16.0
1988	2284.2	129.2	5.7	357.7	na	14.9

Note: All corporate consolidated sales exclude sales of companies owned less than 50%. **a** Net income as a percentage of sales. **b** Excludes nonrecurring gain of $163 million. **c** Excludes nonrecurring gain of $225 million. **d** Excludes nonrecurring loss of $78 million. **e** Net loss. **f** Pro forma. **g** Excludes nonrecurring loss of $59 million. **h** Excludes nonrecurring loss of $34 million. **i** Fiscal year ends Sept. 30. **j** Excludes nonrecurring gain of $53 million. **k** Excludes nonrecurring loss of $55 million. **l** Excludes nonrecurring loss of $113 million. **m** Excludes nonrecurring loss of $147 million. **n** Restated to reflect sale of operations. **o** Excludes nonrecurring gain of $25 million. **p** Excludes nonrecurring gain of $184 million. **q** Excludes nonrecurring loss of $93 million. **r** Excludes nonrecurring gain of $45 million. **s** Excludes nonrecurring gain of $57 million. **t** Excludes nonrecurring loss of $25 million. **u** Excludes nonrecurring net loss of $916 million. **v** Excludes nonrecurring net gain of $23 million. **w** Excludes nonrecurring gain of $32 million. **x** Fiscal year ends March 31. **y** Excludes nonrecurring loss of $122 million. **z** Excludes nonrecurring loss of $74 million. **aa** Excludes nonrecurring gain of $218 million. **bb** Excludes nonrecurring loss of $48 million. **cc** Excludes nonrecurring loss of $55 million. **dd** Excludes nonrecurring loss of $23 million. **ee** Excludes nonrecurring loss of $45 million. **na** = not available.

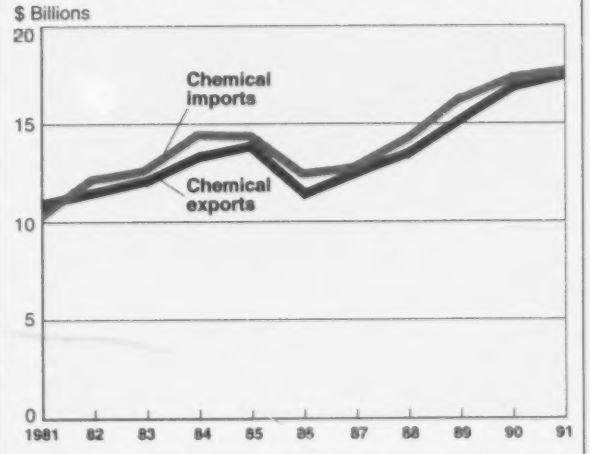
6 FOREIGN CHEMICAL INDUSTRIES - JAPAN

Japanese chemical companies sailed into the unfamiliar waters of an economic downturn last year. They did not enjoy the trip.

Although sales were down only slightly, profits and earnings were significantly lower than a year earlier. For 12 top Japanese chemical companies, earnings fell by 38% between the first and second halves of fiscal 1991, which ended this March. By the end of the period, profit margins averaged a mere 2% of sales, down from 4% or more in 1989 and early 1990.

Production of most chemicals, however, rose last year, helped by slightly higher Japanese chemical exports. Chemical employment also continued to grow, as the top 12 companies boosted total employees 3% to nearly 94,000.

Japan's chemical imports balance exports



Note: Monetary statistics for all years are converted from yen to U.S. dollars on the basis of the average 1991 exchange rate of $1.00 = 134.48 yen. **Source:** Ministry of International Trade & Industry

INDUSTRY TRENDS: Most fields gain slightly

Production index, 1985 = 100	1991	1990	1989	1988	% change 1990–91
All manufacturing	128.2	125.6	120.0	113.1	2%
All chemicals	137.3	134.4	128.7	120.4	2
Inorganic chemicals and pigments	115.7	114.3	114.4	108.4	1
Alkalies and chlorine	119.8	120.9	114.7	110.5	−1
Organic chemicals	137.4	131.7	128.1	115.9	4
Petrochemicals	140.4	136.7	129.1	118.1	3
Aromatics	147.4	137.3	133.2	115.9	7
Cyclic intermediates and dyes	148.4	141.6	135.3	121.2	5
Plastics	141.3	139.6	130.7	120.6	1
Synthetic fibers	102.1	101.2	97.5	95.4	1
Synthetic rubber	118.2	123.1	116.7	112.2	−4
Fertilizer	83.3	85.2	86.6	88.5	−2
Textile chemicals	133.1	126.8	118.7	117.8	5
Medicinals and drugs	159.4	155.2	147.3	136.2	3

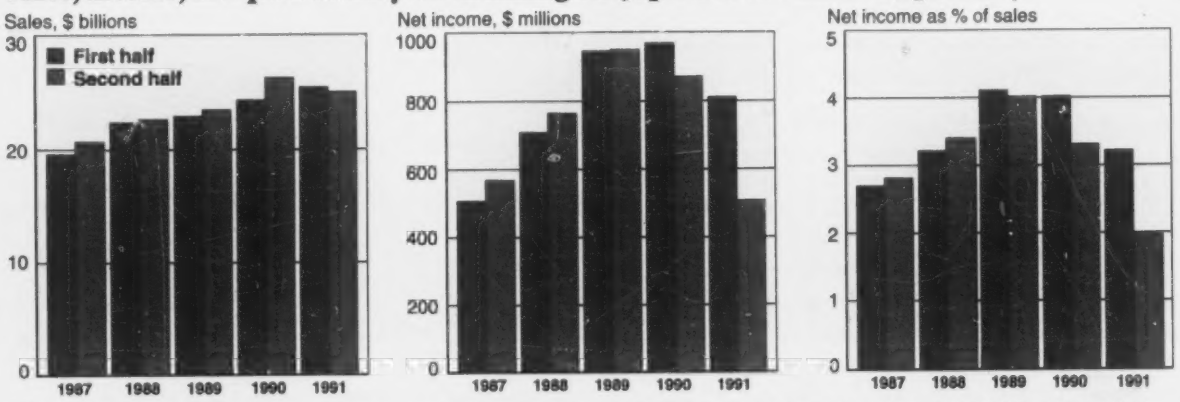
Source: Ministry of International Trade & Industry

PRODUCTION: Stays surprisingly strong

Thousands of metric tons, unless otherwise indicated	1991	1990	1989	1988	% change 1990–91
INORGANIC CHEMICALS					
Ammonia	1855	1831	1831	1817	1%
Ammonium chloride	239	246	274	299	−3
Ammonium sulfate	1781	1803	1717	1834	−1
Calcium carbide	303	294	344	342	3
Calcium superphosphate	420	472	454	476	−11
Carbon black	793	783	779	720	1
Chlorine, liquid	1027	1042	1009	979	−1
Hydrochloric acid	702	637	571	565	10
Nitrogen, millions of cu m	8767	8299	7856	6940	5
Oxygen, millions of cu m	9000	8787	8384	7707	2
Sodium carbonate	1104	1135	1105	1083	−3
Sodium hydroxide	3905	3917	3674	3508	0
Sodium silicate	787	788	756	721	0
Sulfuric acid	7057	6887	6885	6766	3
Titanium dioxide	279	280	275	258	0
ORGANIC CHEMICALS					
Acetaldehyde	384	384	356	333	0
Acetic acid	458	462	432	402	−1
Acetone	369	334	337	289	11
Acrylonitrile	604	593	611	600	2
Benzene[a]	3050	2768	2672	2374	10
Butadiene	847	827	827	780	2
Butanol	334	300	291	276	11
Caprolactam	531	509	469	493	4
Cyclohexane	577	629	656	561	−8
Dioctyl phthalate	305	295	293	273	3
Ethylene	6142	5810	5602	5057	6
Ethylene dichloride	2642	2660	2464	2301	−1
Ethylene glycol	609	501	548	349	22
Ethylene oxide	760	674	681	510	13
Methanol	77	84	82	141	−8
Octanol	295	283	285	273	4
Phenol	495	403	423	358	23
Phthalic anhydride[a]	162	161	160	171	1
Propylene	4337	4215	4036	3682	3
Propylene glycol	301	298	285	265	1
Styrene	2227	2161	1990	1757	3
Terephthalic acid	1434	1338	1200	1150	7
Toluene	1119	1078	1075	1019	4
Toluene diisocyanate	136	116	104	96	17
Urea	730	776	810	790	−6
Xylene	2918	2652	2488	1988	10
PLASTICS					
Phenolic resins	383	385	375	356	−1
Polyethylene	2982	2888	2712	2380	3
Polypropylene	1963	1942	1719	1559	1
Polystyrene	2121	2097	1997	1891	1
Polyvinyl chloride	2055	2049	1972	1838	0
SYNTHETIC RUBBER	1368	1426	1352	1299	−4

a Petroleum-based product only. **Source:** Ministry of International Trade & Industry

Sales, income, and profitability all declining for Japanese chemical companies



Note: Based on results of 12 leading Japanese chemical companies: Asahi Chemical, Dainippon Ink & Chemicals, Hitachi Chemical, Mitsubishi Kasei, Mitsubishi Petrochemical, Mitsui Toatsu Chemicals, Sekisui Chemical, Showa Denko, Sumitomo Chemical, Takeda Chemical Industries, Teijin, and Toray Industries. The fiscal year for most, but not all, of these companies ends March 31. **Sources:** Toyo Keizai Shinposha, Nihon Keizai Shimbon America

COMPANY RESULTS: Profits take a beating at every major chemical company

$ Millions	Net sales	Net income	Profit margin[a]	Total assets	Employees (thousands)
Asahi Chemical Industry[b]					
1991	$7249	$218.2	3.0%	$7726	15.5
1990	7177	287.7	4.0	7424	15.3
1989	6539	247.1	3.8	6632	15.1
1988	6081	209.0	3.4	6106	15.4
Mitsubishi Kasei[b]					
1991	$5408	$ 39.7	0.7%	$7778	9.1
1990	5730	137.9	2.4	7377	9.1
1989	5442	134.1	2.5	6789	8.9
1988	5841	119.0	2.0	6642	8.8
Sumitomo Chemical[c]					
1991	$5214	$113.3	2.2%	$6676	7.9
1990	5330	123.3	2.3	6016	7.8
1989	4474	149.4	3.3	5875	7.7
1988	4135	110.9	2.7	5530	7.7
Sekisui Chemical[b]					
1991	$4833	$158.1	3.3%	$4693	5.8
1990	4589	194.3	4.3	4563	5.6
1989	4120	175.9	4.3	3501	5.4
1988	3749	134.8	3.6	2780	5.2
Toray Industries[b]					
1991	$4455	$202.0	4.5%	$6179	10.4
1990	4353	215.5	5.0	5587	10.3
1989	4083	233.5	5.7	5498	9.6
1988	4113	128.3	3.1	5266	10.0
Showa Denko[c]					
1991	$4289	$ 1.4	0%	$6284	5.4
1990	4236	84.2	2.0	5857	5.3
1989	3907	99.5	2.5	4568	5.1
1988	3505	67.9	1.9	4095	5.1

$ Millions	Net sales	Net income	Profit margin[a]	Total assets	Employees (thousands)
Takeda Chemical Industries[b]					
1991	$4171	$241.4	5.8%	$5525	11.1
1990	4096	275.9	6.7	5405	11.0
1989	4371	278.6	6.4	5414	10.9
1988	4350	256.6	5.9	5104	10.8
Dainippon Ink & Chemicals[b]					
1991	$3848	$ 59.0	1.5%	$4810	7.0
1990	3757	61.7	1.6	4363	7.2
1989	3493	64.0	1.8	4100	6.9
1988	3277	59.2	1.8	3880	6.7
Mitsui Toatsu Chemicals[b]					
1991	$3140	$ 52.9	1.7%	$4739	5.6
1990	3247	92.6	2.9	4631	5.5
1989	3074	89.5	2.9	4064	5.4
1988	2935	79.6	2.7	3750	5.4
Mitsubishi Petrochemical[b]					
1991	$3025	$114.9	3.8%	$4665	3.4
1990	3230	192.3	6.0	4544	3.3
1989	2866	233.6	8.2	4487	3.0
1988	2531	155.1	6.1	3327	2.9
Teijin[b]					
1991	$2522	$110.7	4.4%	$4349	6.8
1990	2422	151.0	6.2	4331	5.7
1989	2273	158.8	7.0	4116	5.7
1988	2322	130.0	5.6	3642	5.8
Hitachi Chemical[b]					
1991	$2314	$ 7.9	0.3%	$1630	5.8
1990	2340	30.1	1.3	1501	5.3
1989	2105	32.5	1.5	1312	5.1
1988	2056	26.9	1.3	1201	5.0

Note: Monetary statistics for all years are converted from yen to U.S. dollars on the basis of the 1991 average exchange rate of $1.00 U.S. = 134.48 yen. **a** Net income as a percentage of sales. **b** Fiscal year ends March 31. **c** Fiscal year ends Dec 31. **Sources:** Toyo Keizai Shinposha, Nihon Keizai Shimbon America

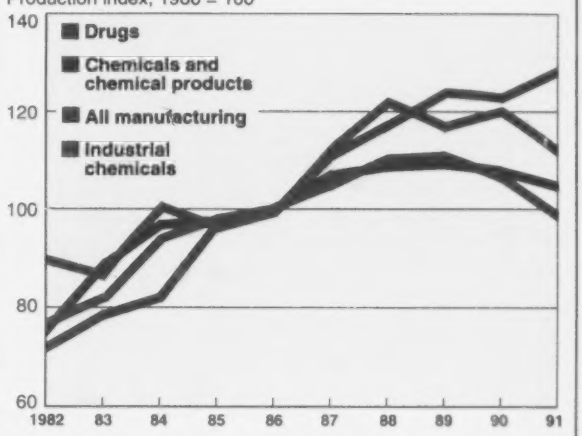
6 FOREIGN CHEMICAL INDUSTRIES - **CANADA**

Last year was not a good one for the Canadian chemical industry. Although a few—very few—companies were able to boost sales, profits were down virtually across the board. A case in point: Novacor's net income plummeted from $325 million in 1990 to only $25 million last year.

There is no shortage of reasons: overcapacity for some of the important commodity chemicals; weak prices; and a recession, both in the Canadian domestic market and in the U.S., by far the major export market for Canadian chemical companies. Canadian chemical exports to the U.S. were down 3.9% last year and overall exports were 3.3% lower than in 1990.

As a result, production of most chemicals was lower, in some cases sharply lower. For industrial chemicals as a group, production fell 7% last year, even more than the 6% drop for all Canadian manufacturing. Drugmakers in general showed their resistance to recession; production for the group rose 5% in 1991. And a very few commodity chemicals also did well: High-density polyethylene production was up almost 26%, even though output of its low-density cousin was down about 5%.

Only drugs survive production downturn



Source: Statistics Canada

Note on currency conversion: Monetary statistics in this section have been converted from Canadian dollars to U.S. dollars on the basis of the average 1991 exchange rate of $1.00 U.S. equals $1.1458 Canadian.

COMPANY RESULTS: Profits nose-dive

$ Millions (U.S.)	Sales	Net income[a]	Profit margin[b]	Capital expenditures	Employees (thousands)
Celanese Canada					
1991	$ 392.6	$ 29.8	7.6%	$ 23.1	1.7
1990	318.2	36.0	11.3	21.0	1.8
1989	346.1	42.2	12.2	15.0	1.9
1988	355.4	42.7	12.0	21.4	2.1
Du Pont Canada					
1991	$1156.7	$ 49.0	4.2%	$124.0	4.2
1990	1231.8	54.5	4.4	157.4	4.3
1989	1236.6	75.5	6.1	96.8	4.1
1988	1202.7	102.9	8.6	87.6	4.0
Esso Chemical Canada[c]					
1991	$ 754.9	$ 1.7	0.2%	$ 22.7	1.4
1990	798.6	20.9	2.6	36.7	1.4
1989	837.8	69.8	8.3	43.6	1.5
1988	864.0	90.8	10.5	27.9	1.4
Novacor Chemicals					
1991	$1966.3	$ 25.3[d]	1.3%	$ 96.9	3.0
1990	2877.5	325.5[d]	11.3	188.5	3.3
1989	2937.7	446.0[d]	15.2	276.7	6.5
1988	1832.8	562.1[d]	30.7	126.5	6.5

a Excludes extraordinary gains and losses. b Net income as a percentage of sales. c Now the chemical division of Imperial Oil Ltd. d Includes operating income only.

PRODUCTION: Very few increases in any sector

Thousands of metric tons	1991	1990	1989	1988	% change 1990–91
INORGANIC CHEMICALS					
Ammonia	3669	3715	4054	4012	−1.2%
Ammonium nitrate	963	1031	1056	990	−6.6
Ammonium phosphate	na	803	952	986	—
Carbon black	157	178	190	181	−11.8
Chlorine	1402	1542	1592	1664	−9.1
Hydrochloric acid	193	187	180	180	3.2
Nitric acid	912	965	1027	919	−5.5
Phosphoric acid, 100% P_2O_5	348	402	470	475	−13.4
Sodium chlorate	695	659	593	503	5.5
Sodium hydroxide	1498	1650	1679	1720	−9.2
Sulfuric acid	2953	3311	3560	3805	10.8
Zinc oxide	na	31	41	62	—
ORGANIC CHEMICALS					
Benzene	712	762	670	695	−6.6
Butadiene	na	192	175	182	—
Butylene	169	176	151	148	−4.0
Ethylene	2425	2434	2317	2346	−0.4
Formaldehyde	114	106	112	123	7.5
Methanol	2223	1884	2015	2101	18.0
Propylene	717	765	719	672	−6.3
Toluene	364	425	397	417	−14.4
Urea	2397	2490	2402	2372	−3.7
Xylenes	391	514	432	399	−23.9
PLASTICS					
Polyesters, unsaturated	33	36	37	43	−8.3
Polyethylene, high density	458	364	303	311	25.8
Polyethylene, low density	1111	1167	1039	1105	−4.8
Polystyrene[a]	167	215	196	216	−22.3

a Includes acrylonitrile-butadiene-styrene resins. na = not available. Source: Statistics Canada

SHIPMENTS: Chemicals slipped, but not as badly as all manufacturing

$ Millions (U.S.)	1991	1990	1989	1988	1987	1986	% change 1990–91
All manufacturing	$241,396	$256,643	$259,180	$251,832	$234,366	$221,106	–6%
Chemicals and chemical products	18,885	19,489	19,206	19,129	17,341	16,267	–3
Industrial chemicals, inorganic	2,075	2,242	2,123	2,094	2,054	1,906	–7
Industrial chemicals, organic	4,070	4,511	4,719	5,230	4,243	3,797	–10
Plastics and synthetic resins	2,257	2,460	2,237	2,184	1,941	1,806	–8
Pharmaceuticals and medicinals	3,290	3,045	2,915	2,715	2,448	2,172	8
Adhesives	157	168	190	181	174	165	–6
Paint and varnish	1,363	1,412	1,342	1,310	1,224	1,085	–4
Soaps and cleansers	1,455	1,325	1,434	1,331	1,282	1,315	10
Toilet preparations	915	858	983	927	876	824	7
Printing ink	208	230	219	223	210	233	–10
Synthetic fibers	784	819	893	850	808	740	–4
Plastic products	4,661	4,977	4,885	4,727	4,255	3,822	–6

Source: Statistics Canada

CHEMICAL IMPORTS: Holding steady

$ Millions (U.S.)	1991	1990	1989	1988
Inorganic chemicals	$1136	$1142	$1220	$ 971
Organic chemicals	1739	1810	1696	1675
Fertilizers and fertilizer materials	190	192	161	212
Synthetic and reclaimed rubber	223	245	240	245
Plastic materials	1364	1327	1280	1174
Plastic film and sheet	460	442	441	421
Other plastic shapes and forms	402	427	438	458
Dyes, except dyeing intermediates	89	95	99	93
Pigments, lakes, and toners	127	116	123	124
Paints and related products	276	255	240	207
Other chemical products	1222	1169	1153	1017
TOTAL	**$7230**	**$7220**	**$7091**	**$6596**
Imports from U.S.	**$5540**	**$5433**	**$5228**	**$4651**
U.S. share	**77%**	**75%**	**74%**	**71%**

Source: Statistics Canada

CHEMICAL EXPORTS: Post unwelcome drop

$ Millions (U.S.)	1991	1990	1989	1988
Chemical elements	$ 154	$ 182	$ 176	$ 212
Other inorganic chemicals	1035	1065	1148	1236
Organic chemicals	1541	1773	1600	1690
Fertilizers and fertilizer materials	1356	1450	1277	1452
Synthetic rubber and plastic materials	1354	1315	1218	1373
Plastics, basic shapes and forms	536	483	419	411
Other chemical products	594	528	436	408
TOTAL	**$6570**	**$6795**	**$6273**	**$6782**
Exports to U.S.	**$4504**	**$4688**	**$4160**	**$4218**
U.S. share	**69%**	**69%**	**66%**	**62%**

Source: Statistics Canada

TRADE BALANCE: Total surplus slips . . .

$ Billions (U.S.)	1991	1990	1989	1988	1987
Total exports	$120.5	$123.7	$117.6	$116.9	$106.0
Total imports	118.1	118.9	118.0	114.5	101.4
Trade balance	2.4	4.8	–0.4	2.4	4.6

. . . as chemical trade deficit worsens

$ Millions (U.S.)	1991	1990	1989	1988	1987
Chemical exports	$6570	$6795	$6273	$6782	$5356
Chemical imports	7230	7220	7091	6596	5436
Chemical trade balance	–660	–425	–818	186	–79

Source: Statistics Canada

PRICES: Synthetic resins are hard hit

Price index, 1986 = 100	1991	1990	1989	% change 1990–91
All commodities	108.6	109.7	109.4	–1.0%
Chemicals and chemical products	115.2	113.8	166.8	1.2
Inorganic industrial chemicals	103.9	103.8	105.8	0.1
Sulfuric acid	110.0	111.1	108.6	–1.0
Chlorine	84.9	93.0	101.4	–8.7
Ammonia	77.2	78.4	84.3	–1.5
Organic industrial chemicals	120.8	118.3	135.0	2.2
Benzene-toluene-xylene	111.4	127.7	125.5	–12.8
Olefins	153.0	133.1	161.2	15.0
Synthetic resins	102.3	111.4	123.0	–8.2
Polyethylene[a]	100.0	115.8	134.9	–13.6
Polystyrene	114.0	127.6	140.7	–10.7
Thermosets	115.1	119.7	125.9	–3.8
Synthetic fibers	105.7	106.6	105.5	–0.8
Agricultural chemicals	115.0	106.9	102.4	7.6
Mixed fertilizers	112.1	105.2	110.8	6.6
Pharmaceuticals	130.6	125.2	119.0	4.3
Paint and varnish	119.7	114.5	111.1	4.5
Soaps and cleansers	118.0	116.0	111.9	1.7
Toilet preparations	116.8	112.9	112.9	3.5
Pigments, lakes, and toners	107.7	106.7	105.8	0.9
Inks	104.4	103.1	101.5	1.3

a Includes both high- and low-density polyethylene. **Source:** Statistics Canada

6 FOREIGN CHEMICAL INDUSTRIES - EASTERN EUROPE

In 1991, economies plummeted in all the nations of Eastern Europe and in the former Soviet Union. Industrial production fell 19% in East Europe and 8% in the former U.S.S.R. Coming after a 15% drop in 1990, East Europe's industrial output has fallen by a third since 1989. And in Albania, Europe's least industrialized nation, industrial output shrank 60% last year.

Chemicals did worse in 1991 than industry overall in several countries: Output sank 34% in Bulgaria, 25% in Romania, 14% in Poland, and 10% in the former Soviet Union. And even when they did better than industry overall, chemicals still fell heavily—down 20% in Czechoslovakia, and 16% in Hungary and Yugoslavia.

Transformation of the region's centrally planned systems into market economies based on political democracy—begun in 1989 amid popular enthusiasm—has lost much of its momentum and vigor, because ambitious reform programs failed to bring quick, tangible improvement in living standards. Rising unemployment and inflation, declining consumption, dismantling of communist-era welfare programs, and ethnic conflicts have added to the instability.

The downspin in the former Soviet Union was exacerbated by the waning of central authority, culminating in breakup into independent republics last December. And Yugoslavia's economy and chemical industry, one of the most modern in the region, have been devastated by last year's outbreak of civil war, splitup into separate republics, and imposition of international sanctions.

The outlook is for continued decline in 1992. For example, chemicals may be one of the industries hardest hit by restructuring in the former Soviet republics: Upgrading or closing of uncompetitive chemical plants could bring large drops in output of most major chemical products.

MAN-MADE FIBERS: Output down substantially for all countries but Hungary

Production, thousands of metric tons	1991	1990	1989	1988	% change 1990–91
NONCELLULOSIC FIBERS					
Bulgaria	na	54	66	67	—
Czechoslovakia	96	143	148	147	−33%
Hungary	28	26	32	33	8
Poland	80	113	169	168	−29
Romania	106	138	170	189	−23
Yugoslavia	59[a]	80	88	101	−26
U.S.S.R.	760[a]	955	973	954	−20
TOTAL	**na**	**1509**	**1647**	**1659**	**na**
CELLULOSIC FIBERS					
Bulgaria	na	4[a]	5	5	na
Czechoslovakia	41	57	60	58	−28%
Hungary	2	4	4	4	−50
Poland	26	36	69	77	−28
Romania	38	71	103	108	−46
Yugoslavia	42[a]	68	71	68	−38
U.S.S.R.	415[a]	522	584	601	−20
TOTAL	**na**	**756**	**896**	**921**	—

a Estimate. **na** = not available. **Sources:** PlanEcon Inc., C&EN estimates

PRODUCTION GROWTH: 1991 brought continued declines for chemicals

% annual change in gross output	1991	1990	1989	1988	1987
East Europe[a]					
All industry	−19.1%	−14.7%	−0.5%	2.8%	2.7%
Bulgaria					
All industry	−27.8	−14.1	2.2	5.1	4.2
Chemicals[b]	−34.3[c]	−25.5	3.8	5.8	5.1
Czechoslovakia					
All industry	−21.0	−3.7	0.8	2.1	2.5
Chemicals[b]	−20.0[c]	−8.4	0.7	2.1	3.2
Hungary					
All industry	−21.5	−5.0	−2.5	−0.3	3.5
Chemicals[b]	−16.5[c]	−5.4	−3.1	1.3	5.8
Poland					
All industry	−11.9	−23.3	−0.5	5.3	3.4
Chemicals	−13.5	−25.0	2.6	6.4	4.3
Romania					
All industry	−18.7	−19.8	−2.1	3.1	2.4
Chemicals	−25.0[c]	−32.5	−3.1	3.2	−3.8
Yugoslavia					
All industry	−20.7	−10.3	0.9	−0.7	0.8
Chemicals[d]	−16.2	−13.2	−2.0	2.0	4.0
U.S.S.R.					
All industry[e]	−7.8	−1.2	1.7	3.9	3.8
Chemicals[e]	−10.1[c]	−0.9	1.4	3.8	4.4
All industry[f]	na	−3.1[g]	−0.8	2.4	2.6
Chemicals[f]	na	−5.3[g]	−2.9	2.2	2.7

a Includes Albania, Bulgaria, Czechoslovakia, Hungary, Poland, Romania, and Yugoslavia. b Includes rubber industry. c Estimated. d For basic chemicals, excluding chemical products. e Figures based on official Soviet statistics. f Figures based on Central Intelligence Agency estimates, giving lower results because of postulated upward bias in official figures. g Preliminary figure. **na** = not available. **Sources:** United Nations Economic Commission for Europe and state central statistical bureaus, Central Intelligence Agency, PlanEcon Inc.

AGRICULTURAL CHEMICALS: Fertilizer supplies down throughout Eastern Europe

Thousands of metric tons	1991	1990	1989	1988	% change 1990–91
Czechoslovakia					
Fertilizer supply[a,b]	na	1,506	1,557	1,595	na
Hungary					
Fertilizer supply[a]	na	671	1,221	1,418	na
Poland					
Fertilizer supply[a,b]	1,751	3,029	3,625	3,277	−42%
Pesticide supply[c]	6.5	7.5	20.6	23.4	−13
Romania					
Fertilizer supply[a]	620	1,227	1,159	1,206	−49
Yugoslavia					
Fertilizer supply[a]	733[d]	767	897	1,015	−4
U.S.S.R.					
Fertilizer supply[a]	20,000[d]	21,639	24,482	27,196	−8
Nitrogen[a]	7,700[d]	8,738	9,918	11,587	−12
Phosphate[a,e]	7,500[d]	7,815	8,175	8,556	−4
Potassium[a]	4,800[d]	5,081	6,381	7,044	−6

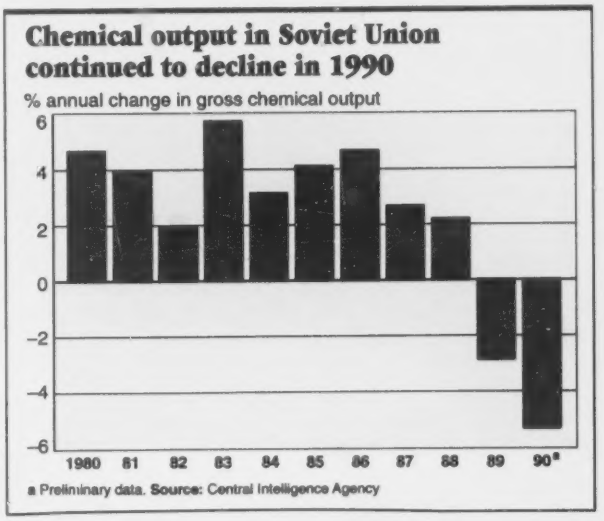
a Nutrient content basis, as N, P_2O_5, or K_2O. b For year ending June 30. c On basis of active substance. d Estimated value. e Includes ground phosphate rock. **na** = not available. **Sources:** Department of Agriculture, Central Intelligence Agency, national central statistical offices

PRODUCTION: Biggest producer, the former U.S.S.R., posted smallest losses

Thousands of metric tons	1991	1990	1989	1988	% change 1990–91
U.S.S.R.					
Sulfuric acid	22,800[a]	27,300	28,276	29,372	–16%
Mineral fertilizers[b]	30,100[a]	31,700	34,254	37,138	–5
Nitrogen[b]	12,100[a]	13,200	14,355	15,815	–8
Phosphate[b,c]	9,200[a]	9,500	9,657	10,013	–3
Potassium[b]	8,800[a]	9,000	10,233	11,300	–2
Plastics	3,975[a]	4,532	4,719	4,634	–12
Sodium hydroxide	2,747[a]	2,973	3,185	3,323	–8
Sodium carbonate	4,006[a]	4,359	4,809	5,098	–8
Synthetic rubber	na	2,400	2,525	2,435	na
Synthetic detergents	na	1,503	1,424	1,301	na
BULGARIA					
Sulfuric acid	na	475	770	780	na
Mineral fertilizers[b]	na	589	724	1,134	na
Nitrogen[b]	na	543	555	984	na
Phosphate[b]	na	47	169	179	na
Synthetic ammonia[d]	na	1,309	1,326	1,342	na
Plastics	180[a]	256	328	363	–30
Sodium hydroxide	na	106	118	124	na
Sodium carbonate	na	1,046	1,153	1,078	na
Synthetic rubber	na	24	25	25	na
Pesticides[e]	na	10	19	18	na
CZECHOSLOVAKIA					
Sulfuric acid	682	1,033	1,142	1,249	–34
Mineral fertilizers[b]	560	877	929	1,025	–36
Nitrogen[b]	357	514	525	596	–31
Phosphate[b,c]	168	257	296	313	–35
Potassium[b,f]	35	106	108	116	–67
Plastics	944	1,174	1,186	1,192	–20
Ethylene	499	619	641	683	–19
Sodium hydroxide	288	335	337	337	–14
Synthetic rubber	45	69	76	79	–35
Pesticides[e]	na	17	18	19	na
HUNGARY					
Sulfuric acid	129	244	482	512	–47
Mineral fertilizers[b]	344	693	897	922	–50
Nitrogen[b]	238	419	513	556	–43
Phosphate[b]	13	56	129	228	–77
Potassium[b,g]	93	218	255	137	–57
Synthetic ammonia[d]	na	444	672	691	na
Plastics	601	603	643	590	–2
Sodium hydroxide[g]	166	193	204	202	–14
Ethylene	254	234	262	264	9
Pesticides[e]	14	24	40	35	–42
POLAND					
Sulfuric acid	1,089	1720	3114	3154	–37
Mineral fertilizers[b]	1396	1769	2590	2718	–21
Nitrogen[b]	1145	1302	1645	1622	–12
Phosphate[b]	251	467	945	962	–46
Synthetic ammonia[d]	na	1768[a]	1941	1923	na
Plastics	593	627	721	723	–5
Sodium hydroxide	311	397	434	444	–22
Ethylene	271	308	322	328	–12
Methanol	na	155	162	168	na
Synthetic rubber	80	103	125	128	–22
Pesticides[e]	17	20	46	45	–15
ROMANIA					
Sulfuric acid	745	1124	1687	1825	–34
Mineral fertilizers[b]	1092	1744	2805	2995	–37
Nitrogen[b]	760[a]	1225[a]	2035	2130	–38
Phosphate[b]	265[a]	425[a]	648	725	–38
Synthetic ammonia[d]	na	1974[a]	2745	2804	na
Plastics	349	473	640	653	–26
Sodium hydroxide	465	552	763	821	–16
Sodium carbonate	478	639	889	918	–25
Ethylene	129[a]	243	332	335	–47
Synthetic rubber	55	102	149	155	–46
Pesticides[e]	18	11	17	na	64
YUGOSLAVIA					
Sulfuric acid	944[a]	1351	1631	1731	–30
Mineral fertilizers[b]	1862[a]	2098	2496	3028	–11
Nitrogen[b]	1663[a]	1842	2103	2487	–10
Phosphate[b]	198[a]	256	393	541	–23
Nitric acid	544[a]	684	730	858	–20
Plastics	534[a]	667	742	724	–20
Sodium hydroxide	146[a]	201	246	437	–27
Detergents	244[a]	295	379	340	–17
Sodium carbonate	144[a]	173	204	214	–17

a Estimated values. b Nutrient content basis, as N, P_2O_5, or K_2O. c Including production of ground phosphate rock for direct applications and phosphate animal feeds. d Nitrogen content. e On basis of active substance. f Imported potash added to domestically produced nitrogen and phosphate to form multinutrient fertilizer. g Including regenerated NaOH. na = not available. **Sources:** Central Intelligence Agency, Department of Agriculture, PlanEcon Inc., official national central statistical offices

Chemical output in Soviet Union continued to decline in 1990



a Preliminary data. **Source:** Central Intelligence Agency

6 FOREIGN CHEMICAL INDUSTRIES - PACIFIC BASIN

SOUTH KOREA

INDUSTRY TRENDS: Inventories growing

Index, 1985 = 100	1991	1990	1989	1988	% change 1990–91
Chemicals, petroleum, coal, rubber, and plastic products					
Production	194.2	172.9	154.8	150.7	12%
Shipments	205.4	174.4	152.7	146.8	18
Inventories	209.3	176.1	155.4	128.6	19
Industrial chemicals					
Production	222.9	188.6	156.6	149.3	18
Shipments	215.7	184.7	151.6	146.1	17
Inventories	258.6	183.0	164.6	117.6	41
Other chemical products					
Production	223.2	205.5	183.0	171.3	9
Shipments	228.0	209.4	186.5	170.0	9
Inventories	266.6	234.6	195.5	159.5	14
Rubber products					
Production	139.2	144.7	128.1	151.1	−4
Shipments	139.4	143.8	128.1	150.9	−3
Inventories	125.3	122.3	123.1	131.2	2
Plastic products					
Production	168.0	158.9	156.9	159.5	6
Shipments	157.7	151.2	145.5	148.3	4
Inventories	233.0	225.9	193.3	148.3	3
All manufacturing					
Production	202.6	186.5	171.3	166.3	9
Shipments	212.2	191.0	171.6	164.6	11
Inventories	217.4	190.7	162.1	137.6	14

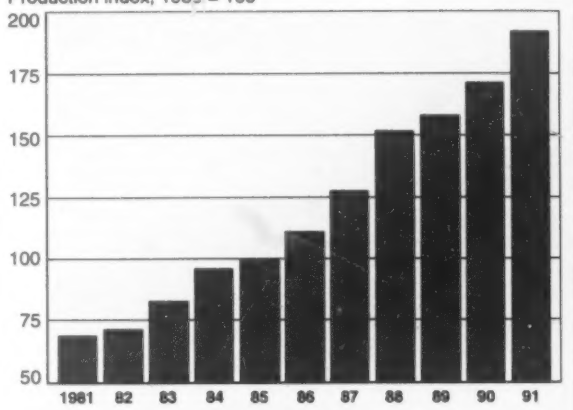
Source: Korean National Statistical Office

FOREIGN TRADE: Chemicals add to deficit

$ Millions	1991	1990	1989	% change 1990–91
Exports[a]	$71,870	$65,016	$62,377	11%
Imports[b]	81,525	69,844	61,465	17
Trade balance	−9,655	−4,828	912	−100
Chemical exports[a,c]	3,191	2,511	2,050	27
Chemical imports[b,c]	8,289	7,434	7,158	12
Chemical trade balance	−5,098	−4,922	−5,108	−4

Note: Data supplied in U.S. dollars by the Korean government. These values are not recalculated to reflect subsequent changes in monetary exchange rates. **a** Free on board. **b** Includes cost, insurance, freight. **c** Includes chemicals and related products. **Source:** Korean Office of Customs Administration

South Korean chemicals production has risen dramatically in past decade



a Includes chemicals, petroleum, coal, rubber, and plastic products.
Source: Korean National Statistical Office

PRODUCTION: Petrochemicals post gains

Thousands of metric tons	1991	1990	1989	1988	% change 1990–91
Complex fertilizers	1883	1959	1985	2076	−4%
Ethylene	1566	1054	663	609	49
Urea fertilizers	871	883	888	1000	−1
Polyethylene	1164	841	637	572	38
Polyester fibers	780	730	654	593	7
Propylene	855	608	375	351	41
Polypropylene	777	574	530	518	35
Polyvinyl chloride	621	541	477	468	15
Polystyrene	758	592	434	341	28
Benzene	561	381	305	308	47
Synthetic detergents	358	342	297	278	5
Sodium hydroxide	371	332	295	311	12

Source: Korean National Statistical Office

AUSTRALIA

PRODUCTION: Major drop for chemicals

Thousands of metric tons, unless otherwise noted	1991[a]	1990[a]	1989[a]	1988[a]	% change 1990–91
Chemicals					
Superphosphate[b]	1574	2659	na[c]	na[c]	−41%
Sulfuric acid, 100%	986	1464	1878	1818	−33
Ammonium sulfate	215	214	165	179	0
Acetylene[d]	3047	3286	na[c]	na[c]	−7
Plastics and resins	948	985	980	990	−4
Detergents and soap	306	319	na[c]	na[c]	−4
Flexible plastic film, sheets[e]	173	183	na[c]	na[c]	−5
Polyethylene[f]	131	141	na[c]	na[c]	−7
Polypropylene	19	19	na[c]	na[c]	4

a Year ending June 30. **b** Includes double and triple superphosphates expressed in terms of single phosphate (9% P equivalent). **c** Not available prior to July 1989 because of revised commodity classification. **d** Thousands of cubic meters. **e** Includes flexible plates, sheets, foil, and strip of plastics; excludes self-adhesive, floor, wall, and ceiling coverings, vulcanized fibers, plastic foam, and plastics reinforced, laminated, or supported with other materials. **f** Low and high density. **na** = not available. **Source:** Australian Bureau of Statistics

FOREIGN TRADE: Chemical exports growing

$ Millions	1991[a]	1990[a]	1989[a]	% change 1990–91
Exports[b]	$41,193	$38,685	$34,131	6%
Imports[c]	38,416	40,311	36,959	−5
Trade balance	2,777	−1,626	−2,828	—
Chemical exports[b]	1,082	971	828	11
Medicinal products	248	209	183	19
Chemical imports[c]	3,986	4,080	3,894	−2
Plastics and polymers[d]	731	810	838	−10
Medicinal products	740	644	545	15
Chemical trade balance	−2,904	−3,109	−3,066	7

Note: Statistics for all years converted from Australian to U.S. dollars on basis of 1991 conversion rate of $1.00 = $A1.2734. **a** Year ending June 30. **b** Free on board. **c** Values for customs purposes, free-on-board basis. **d** Includes polymer and copolymerization products, and condensation, polycondensation, and polyaddition products. **Sources:** Australian Department of Foreign Affairs & Trade, Australian Treasury Department

CHINA

PRODUCTION: Healthy gains in most areas, especially plastics and pharmaceuticals

Thousands of metric tons	1991[a]	1990	1989	1988	% change 1990–91
Synthetic ammonia	21,973	21,251	20,675	19,725	3%
Fertilizer[b]	19,880	18,790	18,547	17,670	6
Sulfuric acid[c]	13,140	11,967	11,408	10,981	10
Sodium hydroxide[c]	3,533	3,338	3,211	2,925	6
Sodium carbonate	3,890	3,799	2,983	2,593	2
Plastics	2,640	2,249	1,973	1,552	17
Man-made fibers	1860	1655	1466	1284	12%
Synthetic detergents	1430	1516	1431	1290	−6
Ethylene	1746	1572	1405	1231	11
Pesticides	250	228	224	202	10
Pharmaceuticals	195	172	196	194	13
Synthetic rubber	335	316	289	251	6

a Preliminary. b Nutrient content. c 100%. **Sources:** State Statistical Bureau of the People's Republic of China, *China Economic News*, Central Intelligence Agency, *China Statistics Monthly*

CHEMICAL IMPORTS: Up sharply in 1991

$ Millions[a]	1991	1990	1989	1988	% change 1990–91
Organic chemicals	$1884	$1131	$1405	$1701	67%
Inorganic chemicals	209	215	469	448	−3
Dyeing, tanning, coloring materials	345	244	226	237	41
Medicinal and pharmaceutical products	490	395	311	384	24
Fertilizers[b]	3229	2605	2364	2335	24
Plastic materials, resins, cellulose esters and ethers	2378	1498	2206	3558	59
TOTAL[c]	$9277	$6648	$7556	$9139	40%

Note: Data supplied in U.S. dollars by the Chinese government. These values are not recalculated to reflect subsequent changes in monetary exchange rates. a Includes cost, insurance, and freight. b Manufactured. c For all chemicals and related products. **Source:** General Administration of Customs of the People's Republic of China

CHEMICAL EXPORTS: Rose slightly

$ Millions[a]	1991	1990	1989	1988	% change 1990–91
Organic chemicals	$ 911	$ 838	$ 690	$ 575	9%
Inorganic chemicals	913	842	794	762	8
Dyeing, tanning, coloring materials	335	366	288	229	−8
Medicinal and pharmaceutical products	743	622	549	468	19
Essential oils, perfumes, cleansing materials	220	319	235	183	−31
Explosives, pyrotechnic products	156	211	244	298	−26
TOTAL[b]	$3818	$3730	$3201	$2897	2%

Note: Data supplied in U.S. dollars by the Chinese government. These values are not recalculated to reflect subsequent changes in monetary exchange rates. a Free on board. b For all chemicals and related products. **Source:** General Administration of Customs of the People

TAIWAN

INDUSTRY TRENDS: Fibers lead growth

Industrial production indexes, 1986 = 100	1991	1990	1989	1988	% change 1990–91
All manufacturing	125.3	116.7	119.0	115.4	7%
Chemical materials	136.6	119.1	110.1	108.0	15
Basic chemicals	126.7	114.8	102.9	94.4	10
Petrochemicals	102.3	94.8	92.0	96.8	8
Fertilizers	115.9	114.1	111.3	113.4	2
Synthetic fibers	172.4	142.7	126.7	113.5	21
Plastics and resins	166.0	139.1	127.3	122.8	19
Chemical products	152.5	139.8	129.1	125.7	9

Source: Taiwan Ministry of Economic Affairs

FOREIGN TRADE: Chemical deficit grows

$ Millions	1991	1990	1989	% change 1990–91
Exports[a]	$ 76,177	$ 67,293	$ 65,241	13%
Imports[b]	62,854	54,714	51,514	15
Trade balance	13,323	12,579	13,727	6
Chemical exports[a,c]	6,743	5,718	5,313	18
Chemical imports[b,c]	9,344	7,621	7,301	23
Chemical trade balance	−2,601	−1,903	−1,988	−37

Note: Statistics for all years converted from New Taiwan dollars (NT$) to U.S. dollars on basis of 1991 conversion rate of $1.00 =NT$26.8. a Free on board. b Includes cost, insurance, and freight. c Includes chemicals, chemical products, and plastic and rubber products. **Sources:** Taiwan Council for Economic Planning & Development, Taiwan Ministry of Finance Department of Statistics

PRODUCTION: Mixed results for chemicals

Thousands of metric tons, unless otherwise noted	1991	1990	1989	1988	% change 1990–91
Polyester[a]	1457	1290	1193	1100	13%
Polyvinyl chloride	978	921	805	779	6
Terephthalic acid[b]	986	798	583	495	24
Ethylene	709	776	766	852	−9
Vinyl chloride	595	665	662	708	−11
Sulfuric acid	776	659	768	664	18
Ammonium sulfate	478	509	524	484	−6
Propylene	389	398	398	441	−2
Acrylonitrile-butadiene-styrene	472	384	311	301	23
Oxygen[c]	364	370	352	350	−1
Polyethylene[d]	334	360	344	390	−7
Styrene	368	355	301	331	4
Calcium superphosphate	363	354	352	315	2
Ammonia, anhydrous	296	263	246	339	13
Paints	246	239	214	247	3
Hydrochloric acid	265	234	217	255	13
Xylene	207	221	213	164	−6
Urea	206	229	237	306	−10
Dioctyl phthalate	192	188	179	167	2
Ethylene glycol	179	178	216	197	1

a Filament and staple. b Pure terephthalic acid. c Millions of cubic meters. d Low and high density. **Source:** Taiwan Council for Economic Planning & Development